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## THE INSECT PESTS OF COTTON IN TROPICAL AFRICA

by E. O. PEARSON

*Director, Commonwealth Institute of Entomology,  
formerly Senior Entomologist, Empire Cotton Growing Corporation*

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Cotton is one of the most important crops cultivated in tropical Africa and no comprehensive account exists of the numerous pests that attack it in that continent. The present work provides a concise and critical résumé of the available information, formerly scattered through the literature, to which a full bibliography is given, and much hitherto unpublished information is also included.

The book contains two introductory sections, the first dealing with the structure of the cotton plant and the background to its cultivation in tropical Africa, and the second giving a general account of cotton pests as regards the systematic groups to which they belong, their geographical distribution and the nature of their association with cotton, together with a summary of what insects and diseases affect the different parts of the cotton plant in Africa, and a discussion of the effects of insect attack on yield. Brief notes are given on each of the cotton-growing areas in Africa south of the Sahara and their principal pests. There is a key to the disorders affecting cotton in Africa, based on symptoms visible in the field.

The main section of the book consists of an account of each of the more important pests, dealing with the taxonomy and distribution, appearance of the different stages, life-history and seasonal activity, nature of the damage inflicted on cotton, alternative host plants, natural enemies, factors affecting prevalence, and control. In the case of species or groups that are not confined to tropical Africa, relevant matter available from research on them elsewhere is included.

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STAMMER (H. J.). Ed. **Beiträge zur Systematik und Ökologie mitteleuropäischer Acarina . . . Band I. Tyroglyphidae und Tarsonemini. Teil 1.** [Contributions to the systematics and ecology of the central European Acarina. Vol. I. Tyroglyphidae and Tarsonemini. Part 1.]—pp. 1–384, 261 figs., many refs. Leipzig, Akad. Verlagsges. Geest & Portig K.-G., 1957. Price DM. 45. **Teil 2.** [Part 2.]—pp. 385–839, 182 figs., many refs. 1959. Price DM. 54.

These are the first two parts of the first volume of a work on the Acarina of central Europe, with special reference to Germany, consisting of sections by various authors, each devoted to a different group. The sections in the first part comprise **Systematik und Ökologie der Tyroglyphiden Mitteleuropas** [Systematics and ecology of the Tyroglyphids of central Europe], pp. 3–231, 182 figs., 5 pp. refs., by E. & F. TÜRK, and **Systematik und Ökologie der deutschen Anoetinen** [Systematics and ecology of the German Anoetini], pp. 233–384, 79 figs., 3 pp. refs., by R. SCHEUCHER, and those in the second are **Systematik und Ökologie der Pyemotiden** [Systematics and ecology of the Pyemotids], pp. 385–625, 85 figs., 7 pp. refs., by H. KRCZAL, **Systematik und Ökologie der Scutacariden** [Systematics and ecology of the Scutacarids], pp. 627–712, 42 figs., 19 refs., by H. KARAFIAT, and **Systematik und Ökologie der Tarsonemiden** [Systematics and ecology of the Tarsonemids], pp. 713–823, 55 figs., 3½ pp. refs., by L. SCHAARSCHMIDT. Indexes to the genera and species of mites mentioned in either part are included in the second.

The arrangement of the different sections is fairly uniform, comprising accounts of general morphology and ecology, keys to genera and species, and a systematic review of species, with information on synonymy, morphology, distribution and habits. Numerous new forms are included. The scope of some of the sections is wider than is indicated by the title of the work, since the section on Scutacarids includes species from the whole of Europe and that on Pyemotids some extra-European forms. No detailed information as to distribution is given for the Tarsonemids. Each section is provided with a summary in which the main findings are reviewed.

REKK (G. F.). **Key to Tetranychid mites.** [In Russian.]—10½ × 6¾ in., 151 pp., 251 figs., 5 pp. refs. Tiflis, Inst. Zool. Akad. Nauk Gruz. SSR, 1959. Price 10 rub. 50 kop.

This work on the Tetranychids of the world consists largely of keys to genera and species, with an introductory discussion of morphology, ecology, life-histories, and economic importance. All the known genera are, so far as possible, included, but those that occur in the Soviet Union are dealt with in most detail. Synonymy is shown in the keys, together with distribution and food-plants.

PRITCHARD (A. E.) & BAKER (E. W.). **The false spider mites (Acarina: Tenuipalpidae).**—Univ. Calif. Publ. Ent. 14 no. 3 pp. 175–274, 51 figs., 4 pp. refs. Berkeley, Cal., 1958.

In this revision of the Tenuipalpids of the world, keys are given to 14 genera and 143 species recognised. Three new genera are erected, including *Cenopalpus*, of which the type is *Brevipalpus spinosus* Donn., 32 new species are described, and numerous changes in nomenclature are made. *B. (Tenuipalpus) geisenheyneri* (Rübs.) is a synonym of *C. spinosus*, of which

the known food-plants do not include fruit trees, whereas the species recorded as *B. geisenheyneri* in an earlier paper by the authors [R.A.E., A 43 21] is *C. (Caligonus) pulcher* (C. & F.), of which *B. oudemansi* (Geijskes) and *B. pyri* Sayed are synonyms. Other new synonymy includes *C. californicus* (Banks) (*australis* (Tucker)), *B. obovatus* Donn. (*inornatus* (Banks)), *bioculatus* (McG.), *pseudocuneatus* (Blanch.) and *Tenuipalpus caudatus* (Dugès) (*palpatus* Donn.).

GEORGHIOU (G. P.). **Plant-feeding mites of Cyprus.**—FAO Plant Prot. Bull. 7 no. 12 pp. 153–160, 2 figs., 18 refs. Rome, 1959.

Mites have of recent years become important pests of many crops in Cyprus, and a list is given of 33 species in six families, together with two predacious species, encountered in 1953–57, with notes on synonymy, habits, food-plants, wider distribution and injuriousness, followed by a list of the food-plants, showing the mites that attack them and those that have occurred in outbreak numbers. The latter include mites of the complex of *Bryobia praetiosa* Koch, on almond, apple, plum and other fruit trees, and of that of *Tetranychus telarius* (L.), on apple, plum, tomato, watermelon and beans; *Eutetranychus orientalis* (Klein), which was misidentified by Pritchard & Baker as *E. banksi* (McG.) [cf. R.A.E., A 44 19] and attacks *Citrus*; *Cenopalpus pulcher* (C. & F.) [cf. preceding abstract], on apple; *Phyllocoptruta oleivora* (Ashm.), which has become one of the most important pests of *Citrus* [cf. 34 371], especially in the eastern and southern coastal areas, but decreases sharply in numbers towards the end of the season; *Aceria* sp., possibly *A. pistaciae* (Nal.), on *Pistacia*; *A. sheldoni* (Ewing), on *Citrus*; *A. oleae* (Nal.), on olive; *A. granati* (Can. & Mass.), on pomegranate; *Eriophyes vitis* (Pgst.), on vines; *Phytoptus avellanæ* Nal., on hazel (*Corylus avellana*); *Aculus (Vasates) lycopersici* (Masse), on tomato; and *Penthaleus major* (Dugès), on cereals. Other mites present include *Eotetranychus pruni* (Oudm.), of which *E. pomi* Sepasgosarian [46 291] is a synonym, on cherry and apple.

MOORE (B. P.) & HEWLETT (P. S.). **Insecticidal synergism with the pyrethrins: studies on the relationship between chemical structure and synergistic activity in the 3:4-methylenedioxyphenyl compounds.**—J. Sci. Fd Agric. 9 no. 10 pp. 666–672, 1 graph, 25 refs. London, 1958.

Compounds containing the methylenedioxyphenyl group, including piperonyl butoxide [containing as principal constituent  $\alpha$ -[2-(2-butoxyethoxy)-ethoxy]-4,5-methylenedioxy-2-propyltoluene], sulfoxide [1,2-methylenedioxy-4-[2-(octylsulphinyl)propyl]benzene] and sesamex (2-(2-ethoxyethoxy)ethyl-3,4-methylenedioxyphenyl acetal of acetaldehyde), have been shown to be important synergists for use with pyrethrins, and investigations to establish the minimum molecular requirements for synergism in compounds of this type and to modify it so as to obtain highly synergistic compounds are described. The test insects were adults of *Alphitobius laevigatus* (F.), and the results of topical application of cyclohexanone solutions of pyrethrins to them, with or without the addition of various open-chain and cyclic methylene ethers and esters, indicated that synergism of the type under consideration is specific to the methylenedioxyphenyl group and that it has a physiological basis. The chemically inert alkyl side-chains presumably have a physical effect, facilitating the penetration and possibly determining the orientation of the methylenedioxyphenylalkane

molecule at the site of action, and the minimal requirements therefore appear to be a methylenedioxyphenyl nucleus with a short lipophilic side-chain. Substitution in the methylene group inhibited synergistic activity, and nuclear substitution by polar groups reduces lipid solubility and so does not generally produce good synergists. Ether linkages and sulfoxide, sulphone and sulphonate groups have been shown to be important in the side-chain, and comparison of a series of piperonyl ethers, with 12-atom side-chains containing 1, 2, 3 or 4 ether linkages, showed most synergistic effect for three linkages, the piperonyl ether of ethylene glycol mono-n-butyl ether being superior to piperonyl butoxide. The more soluble sulphur-containing compounds, sesamol octane-1-sulphonate, sesamol decane-1-sulphonate and homopiperonyl octane-1-sulphonate, proved to be potent synergists.

VENKATRAO (S.), NUGGEHALI (R. N.), SWAMINATHAN (M.), PINGALE (S. V.) & SUBRAHMANYAN (V.). **Effect of insect infestation on stored grain. III. Studies on kaffir corn (*Sorghum vulgare*).—*J. Sci. Fd Agric.* 9 no. 12 pp. 837–839, 11 refs. London, 1958.**

In this part of a series recording experiments carried out in India [*cf. R.A.E., A* 46 208, etc.], an account is given of a test in which sorghum grain stored in bags was infested with *Calandra oryzae* (L.) and examined at monthly intervals for five months, in comparison with uninfested samples. The results showed that the weevils caused a heavy loss in weight of the grain. Insect excreta and body fragments were present, and the content of uric acid (an important constituent of the excreta), degree of kernel damage and acidity of the fat increased with the progress of infestation, while the thiamine content decreased. The flour and the unleavened bread prepared from it were unacceptable to consumers when the infestation continued for more than three months.

HUGHES (J. T.) & READ (W. H.). **An investigation of the dermal exposure to parathion by workers engaged in handling cucumbers and tomatoes under glass after smoke and aerosol treatments.—*J. Sci. Fd Agric.* 10 no. 1 pp. 31–38, 9 refs. London, 1959.**

The following is virtually the authors' summary. The hazard to workers handling tomato and cucumber plants treated with parathion for the control of *Tetranychus telarius* (L.) in greenhouses in Britain was studied by determining the residue of insecticide on the foliage and quantities transferred to the gloves of workers handling the treated plants. Figures are given to show that the amounts of parathion picked up on the hands of such workers are unlikely to be hazardous.

COLLINGWOOD (C. A.) & BROCK (A. M.). **Ecology of the black currant gall mite (*Phytoptus ribis* Nal.).—*J. hort. Sci.* 34 no. 3 pp. 176–182, 5 figs., 4 refs. London, 1959.**

Investigations on the seasonal history of populations of *Cecidophyes* (*Phytoptus*) *ribis* (Westw.) on black currant [*cf. R.A.E., A* 16 231] were made in 1957–58 in the eastern midlands of England. Samples of galled buds were taken once a fortnight and broken up in water, and the mites and eggs were counted after soaking for an hour, followed by stirring for

20 minutes. The results showed that there were two extended oviposition periods in the year; eggs were not found in new buds invaded in spring until some time in late June. They then increased in numbers to a maximum in late September and fell to a very low level for 4-6 weeks in midwinter, when the mite population averaged 3,500-4,500 per infested bud. Oviposition began again in January, and the population increased to a maximum of up to 35,000 per gall by late March, after which it fell with increasing rapidity, owing to migration of the mites. These results suggest that individual mites are long-lived and that there are two generations a year, with prolonged oviposition periods. This view was supported by the discovery of very small numbers of apparently non-breeding mites in buds of normal appearance during the winter, though the occurrence of five generations in the year has been suggested [cf. 46 70].

Mites that left the old galls in spring wandered freely over the stems and into the new growth throughout the flowering period, from the late grape stage onwards, which is a time of rapid shoot growth and new bud formation. Migration did not appear to be due solely to temperature, as it could be induced by bringing shoots into a warm room only after midwinter. Towards the end of April, small numbers of mites penetrated to the centres of new buds, where they remained for several weeks without apparently damaging the tissues; oviposition began when flower rudiments were forming in uninfested buds. Some mites remained in the old galls, but more than 90 per cent. of the latter had withered by mid-June and the mites in the remainder appeared to be of no importance in the development of fresh infestations.

It was calculated that less than 1 per cent. of the mites from the old galls establish themselves in new ones. Plot samples taken in successive seasons showed that infestation increased rapidly until about 35 per cent. of the buds were galled, when an apparent equilibrium was reached. Contamination of uninfested plants with infested material showed that mites could be transferred at any stage of plant development from the early grape stage to fruit swell, but peak invasion, as measured by population estimates and gall counts in the autumn, occurred in the period immediately after full bloom. In 1957 and 1958, single applications of an endrin spray gave the greatest control when applied at fruit set and the least at the grape stage.

The direct effects of mite injury include the suppression of flower development in infested buds, localised foliage distortion and the proliferation of side shoots at the expense of extension growth.

SCHIMITSCHEK (E.). Ed. **Festschrift zum 60. Geburtstag von W. Zwölfer.** [Commemorative volume for W. Zwölfer's sixtieth birthday.]—Z. angew. Ent. **41** pt. 2-3 pp. 113-410, illus. Hamburg, 1957.

The papers published in this commemorative number include the following:—

ROONWAL (M. L.). **Brief history and modern trends of forest entomological research in India** (pp. 121-138, 6 figs., 2 pp. refs.) (with a summary in German). This is a review of research on insect pests of forests in India, with special reference to the work of the Forest Research Institute, Dehra Dun, which was established in 1906 and the various departments of which are described.

OSSOWSKI (L. L. J.). **Über *Kotochalia junodi* (Heyl.)—Psychidae—einen Grossschädling in Schwarzakazienwäldern von Südafrika** [*K. junodi*, a major pest in forests of black wattle in South Africa] (pp. 139-152, 5 figs., 9 refs.) (with a summary in English). *Kotochalia junodi* (Heyl.) has become the most important insect pest of black wattle (*Acacia mollissima*) in South

Africa. Its bionomics, the damage it causes and the normal course of outbreaks are described, its natural enemies are reviewed, and work on its control by means of insecticides is summarised. Over 70,000 acres of forest were sprayed in 1952-56, usually with toxaphene in light diesel oil, and good control was obtained under certain conditions [cf. *R.A.E.*, A 47 452]. Earlier attempts at control by means of the fungus, *Isaria psychidae*, met with some success, but only in areas of high rainfall. A virus has more recently been tested, with better results [cf. 47 453].

KANGAS (E.). Über die Larve, Puppe und die Biologie von *Pissodes gyllenhali* Gyll. (Col., Curculionidae) [On the larva, pupa and bionomics of *P. gyllenhali*] (pp. 153-158, 6 figs., 7 refs.) (with a summary in English). The larva and pupa of *Pissodes gyllenhali* (Sahlb.) are described, and an account is given of its bionomics on spruce in Finland. There is one generation a year, and dead trees of which the bark is still fresh and moribund trees are attacked.

BRAMMANIS (L.). Zur Kenntnis des Vorkommens und der Bekämpfung der Nadelholzmilbe, *Paratetranychus ununguis* (Jac.) (Acari, Trombidiformis) [Contribution to knowledge of the occurrence and control of *Oligonychus ununguis*] (pp. 159-171, 1 fig., 21 refs.) (with a summary in English). The information here given on the occurrence of *Oligonychus* (*Paratetranychus*) *ununguis* (Jacobi) in spruce nurseries in Sweden and other parts of north-western Europe is similar to that already noticed [45 458]. The mite is stated to be common in Finland, to occur on spruce in Canada, and to be readily controlled by several modern systemic and other acaricides.

VOÛTE (A. D.). Regulierung der Bevölkerungsdichte von schädlichen Insekten auf geringer Höhe durch die Nährpflanze (*Myelophilus piniperda* L., *Retinia buoliana* Schiff., *Diprion sertifer* Geoffr.) [Regulation of the population density of injurious insects at low levels through the food-plant (*M. piniperda*, *Rhyacionia buoliana*, *Neodiprion sertifer*)] (pp. 172-178, 2 graphs, 6 refs.) (with a summary in English). Populations of forest pests may be prevented from rising above low levels by unfavourable conditions of the trees infested, and instances are cited from investigations in Holland. The numbers of adults of *Myelophilus piniperda* (L.) in plantations of Scots pine [*Pinus sylvestris*] increased with the numbers of breeding sites available in the form of recently felled trees with the bark on and trees in poor condition, so that the density of this insect is regulated by the availability of oviposition sites. Newly hatched larvae of *Rhyacionia* (*Retinia*, *Evetria*) *buoliana* (Schiff.) bored into pine needles only when the moisture content of the tree was below normal, and the number of eggs laid by *Neodiprion* (*Diprion*) *sertifer* (Geoffr.) increased up to a limit with the percentage of water in the pine needles. There was some evidence that an outbreak of *Diprion pini* (L.) on *P. sylvestris* in 1951 was associated with some factor retarding normal tree growth.

CROOKE (M.). A brief review of the British conifer feeding sawflies (pp. 179-183) (with a summary in German). The sawflies that attack pine, larch and spruce in Britain and their importance as forest pests are reviewed. Those of economic significance are *Diprion pini* (L.) and *Neodiprion sertifer* (Geoffr.) on pine and *Pristiphora erichsonii* (Htg.), *P. laricis* (Htg.) and *Anoplonyx destructor* Benson on larch. Of the nine species that infest spruce, none causes much damage.

JAHN (E.) & SINREICH (A.). Zum Auftreten des Kiefernspanners, *Bupalus piniarius* L. im Burgenland in den Jahren 1952-1956 [The occurrence of *B. piniarius* in the Burgenland in 1952-56] (pp. 184-195, 4 figs., 1 map, 7 refs.) (with a summary in English). Details are given of an outbreak of *Bupalus piniarius* (L.) that occurred on pine in the Burgenland province of Austria. It began in 1952, reached its peak in 1955, and subsided in 1956. The

extent of the damage was reduced by dusting with methyl-parathion and DDT and by other insecticidal treatments.

PFEFFER (A.). **Der Verlauf des Borkenkäferbefalles und der Holzfeuchtigkeit von künstlich zum Eintrocknen gebrachten Fichtenstämmen** [The course of bark-beetle infestation and the moisture content of spruce logs artificially dried] (pp. 196-207, 2 figs., 24 refs.) (with a summary in English). The author reviews the complexes of bark-beetles that attack spruce in Czechoslovakia and gives details of investigations in 1953-54 showing that treatment of the trunks of standing trees with a compound of sodium and arsenic to hasten drying and facilitate the removal of the bark did not render the trees unattractive to *Trypodendron (Xyloterus) lineatum* (Ol.), which favours sapwood of high moisture content, but killed the beetles before they could oviposit. The treatment could thus be used to control this pest. The moisture content of treated trees remained high, so that they could not be used as trap-trees against other species (*Ips typographus* (L.) and *Polygraphus poligraphus* (L.)) without felling.

PATOČKA (J.). **Beitrag zur Kenntnis der Schmetterlinge an Tannen** [Contribution to knowledge of Lepidoptera on firs] (pp. 208-215, 6 figs., 7 refs.) (with a summary in English). The larvae and pupae of *Ypsolophus coriacellus* (H.-S.) and *Pammene oxsenheimeriana* (Zell.) are described, and observations on the bionomics of these species are recorded. They were found infesting fir [*Abies alba*] in central Slovakia.

KOVAČEVIĆ (Ž.). **Einfluss von Witterung und Nahrungsart auf das Auftreten und die Verbreitung des amerikanischen Webebären—*Hyphantria cunea* Drury in Jugoslawien** [Influence of weather and food on the occurrence and distribution of the American *H. cunea* in Yugoslavia] (pp. 216-232, 22 graphs, 7 maps, 10 refs.) (with a summary in English). Maps are given showing the distribution of *Hyphantria cunea* (Dru.) in Croatia in each of the years 1951-56, and the spread of the insect is discussed in relation to weather conditions. Observations have shown that there are two generations and a partial third in the year if conditions are suitable, but three complete generations can be produced in the laboratory. *H. cunea* is polyphagous, and the leaves of mulberry, plum, apple and cherry are the most favourable food for larval development. Other food-plants are noted. Spread is most rapid in lowlands and along roads, and the insect rarely occurs in the mountains, which may hinder its spread to the south and west.

ALKAN (B.). **Teeschädlinge in der Türkei** [Tea pests in Turkey] (pp. 233-242, 8 figs., 13 refs.) (with a summary in English). Tea has been grown on the north-east coast of Turkey since about 1924, and the first crop was picked in 1939. The bushes are infested by numerous indigenous pests, including *Toxoptera aurantii* (Boy.), *Pulvinaria floccifera* (Westw.), *Coccus hesperidum* L., *Ceroplastes sinensis* Del G. and *Sparganothis pilleriana* (Schiff.), of which the first two are the most important, and the roots are attacked by larvae of *Melolontha melolontha* (L.) and *Polyphylla fullo* (L.) and injured by the burrowing activities of *Gryllotalpa gryllotalpa* (L.). Notes on bionomics, alternative food-plants and control are included.

WEISER (J.). **Über Krankheiten des Wollästers, *Eriogaster lanestris* L.** [Diseases of *E. lanestris*] (pp. 243-245, 2 figs., 2 refs.) (with a summary in English). *Eriogaster lanestris* (L.) is a common pest of fruit trees and bushes in central and southern Slovakia. Larvae collected near Voznice were found to be infected by Microsporidia of two species, and these are described as *Nosema zwölferei* and *Thelohania eriogastri*, spp.n. The first affects the mid-intestine and the second the hypodermis. Infected larvae die before the final moult.

DELUCCHI (V.), PSCHORN-WALCHER (H.) & ZWÖLFER (H.). **Cnemodon-Arten (Syrphidae) als Räuber von *Dreyfusia piceae* Ratz. (Adelgidae). II.**

**Morphologie und Biologie von *Cnemodon dreyfusiae* Del. et P.-W., nebst Beobachtungen über *C. latitarsis* Egger** [*Cnemodon* spp. as predators of *Chermes piceae*. II. Morphology and biology of *C. dreyfusiae*, together with observations on *Cnemodon latitarsis*] (pp. 246-259, 6 figs., 13 refs.) (with a summary in English). *Cnemodon dreyfusiae* Delucchi & Pschorn-Walcher and *C. latitarsis* Egg. are common predators of *Chermes (Dreyfusia) piceae* Ratz. on fir [*Abies alba*] in Europe [cf. 46 201, 247]; *Cnemodon pubescens* Delucchi & Pschorn-Walcher apparently has other hosts. In the present paper, the immature stages of *C. dreyfusiae* are described and observations in Switzerland on the bionomics of this species and of *C. latitarsis* recorded. *C. dreyfusiae* has 2-3 generations a year, with a facultative larval diapause in summer and an obligatory period of larval quiescence in winter. *C. latitarsis*, about which less is known, has apparently only one generation a year, is restricted to the spring generation of the host, and undergoes diapause in the last larval instar. *Syrphophagus (Microterys) aeruginosus* (Dalm.) and three species of *Diplazon* emerged from mixed puparia of the two species, in which *C. dreyfusiae* greatly predominated; they are regarded as primary parasites of the latter.

BALTENSWELER (W.) & MOREAU (J. P.). **Ein Beitrag biologisch-systematischer Art zur Kenntnis der Gattung *Phytodietus* (Hymenoptera)** [Biological and systematic contribution to knowledge of the genus *Phytodietus*] (pp. 272-276, 4 figs., 6 refs.) (with a summary in English). Notes are given on the habits of an unidentified species of *Phytodietus* found parasitising the pupae of *Enarmonia (Eucosma) griseana* (Hb.) during the recent outbreak of the latter on larch in the Engadine region of Switzerland [cf. 48 141]. Eggs of this Ichneumonid were laid mostly dorsally on the second or third segments, but their distribution was influenced by the degree of superparasitism, which became high after the outbreak had reached its peak in 1954. The species is ectoparasitic.

ČAPEK (M.). **Beitrag zur Kenntnis der Entomophagen von *Pityokteines vorontzovi* Jac. und anderen Tannenborkenkäfern** [Contribution to knowledge of the parasites of *P. vorontzovi* and other fir bark-beetles] (pp. 277-284, 8 figs., 22 refs.) (with a summary in English). An outbreak of *Choristoneura murinana* (Hb.) and *Eucosma nigricana* (H.-S.) on fir [*Abies alba*] in central Slovakia in 1947 was followed by heavy damage by bark-beetles, including *Ips (Pityokteines) vorontzovi* Jakobs. The literature on the insect enemies of the beetles concerned is reviewed, and a list is given of those attacking *I. vorontzovi*, with notes on their habits. The most important were *Cosmophorus cembrae* Ruschka and *Roptrocercus (Pachycercus) eccoptogastri* (Ratz.), which were parasitic, and *Medetera* sp., which was predacious. The first is redescribed.

DOSSE (G.). **Morphologie und Biologie von *Typhlodromus zwölfperi* n.sp. (Acar., Phytoseiidae)** [Morphology and bionomics of *T. zwölfperi*, sp.n.] (pp. 301-311, 5 figs., 7 refs.) (with a summary in English). A species of *Typhlodromus* found on apple trees near Oldenburg is described as *T. zwölfperi*, sp.n., and its differentiation from other species of the genus is discussed. The trees were infested by *Panonychus (Metatetranychus) ulmi* (Koch) and *Czenspinskia lordi* Nesbitt, which probably served as prey, and also by Tarsonemids and Eriophyids. In the laboratory, *T. zwölfperi* fed on all stages of a form of *Tetranychus telarius* (L.) (*urticae* Koch). Development lasted 8.6 days at 25-26°C. [77-78.8°F.] and 21.6 days at 15-16°C. [59-60.8°F.], and considerable amounts of moisture were required. Neither *Typhlodromus zwölfperi* nor *T. tiliae* Oudem. was able to feed on uninjured winter eggs of *P. ulmi*. Animal food was essential for development and oviposition.

ZOEBELEIN (G.). **Zur Beeinflussung der Insektenfauna des Waldes durch**

**chemische Grossschädlingsbekämpfungen. 1. Mitteilung** [The effect of chemical control of major pests on the insect fauna of the forest. First communication] (pp. 320-332, 2 graphs, 6 refs.) (with a summary in English). Investigations were made in Bavaria in 1956 on the effect on the total insect fauna of forests of 10 per cent. DDT aerosols applied by the TIFA apparatus [cf. 35 259] for the control of *Dasychira pudibunda* (L.) and *Lymantria monacha* (L.). The results are discussed in detail. It was found that the numbers of beneficial, indifferent and injurious insects killed were in the proportion 6:4:90 in the *Dasychira* work and 11:8:81 in the *Lymantria* work.

MERKER (E.), EICHORN (O.) & v. KLEIST (I.). **Die vernichtende Wirkung von klimatischen Kälteeinbrüchen auf Tannenläuse der Gattung *Dreyfusia*** [The lethal effect of cold spells on fir aphids of the genus *Chermes*] (pp. 333-352, 3 graphs, 13 refs.) (with a summary in English). A period of cold in February 1954 in which the temperature fell to  $-17^{\circ}\text{C}$ . [ $1.4^{\circ}\text{F}$ .] and there were nine days of frost but precipitation was almost normal, had little effect on the overwintering population of *Chermes* (*Dreyfusia*) *piceae* Ratz., *C. (D.) nordmannianae* Eckstein (*nüsslii* (Börner)) and *C. (D.) prelli* (Grosmann) on fir [*Abies alba*] near Freiburg, in the Black Forest region of Germany, but many of the hiemosistentes and their eggs died during a further cold period in April, when the temperature fell to  $-4^{\circ}\text{C}$ . [ $24.8^{\circ}\text{F}$ .]. A prolonged cold period in February 1956, with temperatures falling to  $-22^{\circ}\text{C}$ . [ $-7.6^{\circ}\text{F}$ .] and much reduced precipitation, was lethal to individuals in exposed situations. The sum of negative temperatures (degrees below  $0^{\circ}\text{C}$ . [ $32^{\circ}\text{F}$ .] multiplied by time in hours) was  $-1925$  hour-degrees C. in February 1954 and  $-6061$  in February 1956, and the lethal limit is apparently between these two figures. *C. piceae* is thus less resistant to cold in Europe than in Canada [cf. 42 263].

WELLENSTEIN (G.). **Die Beeinflussung der forstlichen Arthropodenfauna durch Waldameisen (*Formica rufa* Gruppe), I. Teil** [The effect of wood ants (the group of *F. rufa*) on the arthropod fauna of forests, part I] (pp. 368-385, 10 figs., 36 refs.) (with a summary in English). The effect of predacious ants of the group of *Formica rufa* L., with Gösswald's classification of which [cf. 42 60, etc.] the author disagrees, on the arthropod fauna of forest stands was studied in Germany by the release and continued observation of injurious insects, quantitative studies on the activity of the ants outside their nests, and analysis of the arthropod fauna at different distances from the nest [cf. 43 395]. It was found that activity was dependent on temperature and showed a daily rhythm, reaching its peak in the afternoon and continuing into warm nights. Heavily chitinised beetles and hairy caterpillars were resistant to attack, though the acid of the ants killed even large Lamellicorns. Except for pupae of *Lymantria monacha* (L.), eggs and pupae of important forest Lepidoptera were not perceived. Sawfly larvae were perceived less than larvae of *Panolis flammea* (Schiff.). In areas infested by *Cephalcia abietis* (L.), the numbers of larvae in diapause found near nests were less than half those found in ant-free areas, and the same was observed for the cocoons of important parasites. Bark aphids (*Lachnus*) were protected by the ants.

KRUEL (W.). **Bemerkenswertes Auftreten von Waldinsekten unter dem Einfluss klimatisch-meteorologischer Faktoren der letzten 10 Jahre im östlichen Deutschland** [Notable occurrences of forest insects under the influence of climatic-meteorological factors in eastern Germany in the last ten years] (pp. 386-394) (with a summary in English). The occurrence of insect pests of forests in north-eastern Germany since the war is discussed in relation to prevailing climatic influences. During these years, a

continental climatic period was followed by a more atlantic one. The former was favourable and the latter unfavourable for insect abundance.

SCHAEFFENBERG (B.). **Infektions- und Entwicklungsverlauf des insektentötenden Pilzes *Beauveria bassiana* (Vuill.) Link** [The course of infection and development in the entomophagous fungus *B. bassiana*] (pp. 395-402, 5 figs., 10 refs.) (with a summary in English). Descriptions are given of the pathology and development of *Beauveria bassiana* in fourth-instar larvae of *Leptinotarsa decemlineata* (Say) and larvae of *Melolontha*. It was observed that the vital organs of the larvae are not attacked during the parasitic phase of fungus development, but are invaded by the saprophytic mycelium after death. Death is probably due to inhibition of circulation resulting from aggregation of conidia in the haemolymph and to toxicants.

BECKER (G.). **Holzerstörende Insekten im Hafenbau- und Werftholz von Chioggia (Norditalien)** [Wood-destroying insects in timbers in the harbour and wharves of Chioggia (North Italy)] (pp. 403-410, 6 figs., 18 refs.). Observations on structural timbers in the harbour of Chioggia, near Venice, in the autumn of 1955 showed the presence of *Kaloterms flavicollis* (F.) in oak and pine, sometimes in close proximity to the water, *Hylotrupes bajulus* (L.) in buildings and other structures, Oedemerids in damp wood in the open, several Anobiids (*Oligomerus ptilinoides* Woll., *Nicobium castaneum* (Ol.), *Anobium fulvicorne* Sturm and *A. punctatum* (Deg.)) in the interior of buildings, and *Codiosoma (Pselactus) spadix* (Hbst.) in damp wood in and out of doors. Larvae of *H. bajulus* were parasitised by *Sclerodermus domesticus* Latr., and Anobiid larvae by this Bethyloid and *Tineophoctonus armatus* (Ashm.).

BULLMANN (O.) & FABER (W.). **Studien zum Getreidewanzenproblem.** [Studies on the cereal-bug problem.]—*Pflanzenschutzberichte* 20 pt 3-10 pp. 33-160, 44 figs., 16 pp. refs. Vienna, 1958. (With a summary in English.)

An outbreak of cereal bugs occurred on wheat in Lower Austria in 1953-54, and investigations on the species concerned, their bionomics and the nature of the damage caused were carried out in 1955-56; infestation was low in these last two years. The results are discussed in relation to the literature, and the following is based mainly on the authors' summary of them.

The species present comprised *Eurygaster maura* (L.) and *Aelia acuminata* (L.), which were the most important [cf. R.A.E., A 25 309], *E. austriaca* (Schr.), *A. rostrata* Boh. and *Eurydema ventrale* Kol., which were less numerous, *Palomena prasina* (L.) and *Carpocoris pudicus* (Poda), which were of little significance, and *Eurygaster testudinaria* (Geoffr.) which was not differentiated from *E. maura*. The highest populations occurred in Lower Austria and Burgenland.

Females of *E. maura* oviposited four times on the average and laid an average total of 55 eggs, but some oviposited nine times, laying up to 124 eggs. Females of *E. austriaca*, *A. rostrata* and *A. acuminata* were observed to lay 87, 94 and 133 eggs in 6, 8 and 12 batches, respectively, and some might also have oviposited earlier. Oviposition began in the field in late May or early June, and the egg stage lasted 8-14 days for *E. maura*, 7-14 for *A. acuminata*, 8-12 for *E. austriaca* and 9-11 for *A. rostrata* at 17-22°C. [62.6-71.6°F.], egg mortality averaging 30.6, 18.8, 35.4 and 37.1 per cent., respectively. Changes in the pigmentation of the eggs during incubation are described. The duration of the nymphal instars fluctuated widely, even between individuals reared from the same batch of eggs, but the averages were found to be 6.1, 10.2, 8.1, 7.9 and 10.2 days for the five successive instars of *E. maura* at 17-22°C., 6 and 10.2 days for the first two of *E.*

*austriaca*, and 5.2 days for the first instar of *A. rostrata*. Mortality in the five instars of *E. maura* averaged 26.1, 71.3, 56.2, 81.3 and 41.7 per cent., respectively, in the laboratory, but was lower in the field. Complete development of *E. maura* required 52–60 days at 19–23°C. [66.2–73.4°F.], and the earliest dates for the final moult in *E. maura* and *A. acuminata* were 21st July and 5th August, respectively. The first young adults of *E. austriaca* were seen in the field on 28th July, when examination of the bugs present in the refuse after combine-harvesting showed that 67.2 per cent. of the examples of this species and 36.2 per cent. of those of *E. maura* were adults and the remainder fifth-instar nymphs. Hibernation on a scale comparable with that in some other countries was not observed, and no overwintering sites were found.

Since the bugs have only one generation a year, weather favourable to them must occur in at least two successive years for populations to reach outbreak levels. Cool weather in June has an adverse effect, and a direct correlation was found between the degree of population increase and the number of days with a maximum temperature above 25°C. [77°F.]. No such relation existed with rainfall. Although two Scelionids, *Microphanurus* (*Telenomus*) *semistriatus* (Nees) and *Telenomus* sp., parasitised 5–14 per cent. of the eggs of *E. maura*, *E. austriaca* and *A. acuminata* in cages in 1956, their value in the field was not determined. Parasitism of nymphs and adults by Tachinids was negligible, but the elimination of the bugs by combine-harvesting afforded considerable control.

The bugs also infested other cereals, but wheat was the most severely damaged. The greatest injury was caused by their feeding on the grains at the milky stage of development, as a result of which the weight per 1,000 grains of the variety used was reduced from 1.46 to 0.29–1.27 oz. The germination rate of punctured wheat grains was reduced by about 18.8 per cent., and that of rye and barley by about 52 and 24 per cent., respectively, though there were no ultimate differences between the plants that developed from injured or sound grains. The feeding of *E. austriaca* and *A. rostrata* on the grains and inner surface of the glumes induced the growth of so-called saliva cones [cf. 20 205–206], which had not previously been associated with these species. Populations fluctuate markedly, for whereas in 1954 averages of 3.1–4.3 per cent., ranging up to 18 per cent., of the wheat crop was damaged in Lower Austria, only 0.4 per cent. was injured in 1955–56. Such levels of infestation are not considered serious, since infestations of less than 5 per cent. are not thought appreciably to alter the gluten content [cf. 40 128]. Control measures are discussed, and a brief report is given of a test carried out in July 1956, in which a low-volume emulsion spray of diazinon applied to winter wheat from an aeroplane flying 3–13 ft. above the plants reduced the percentage of grains punctured from 0.52 to 0.28.

MERKER (E.) & NIECHZIOL (W.). **Die Abhängigkeit der Massenvermehrung der Kleinen Fichtenblattwespe (*Lygaeonematus pini* Retz.) vom Wasserhaushalt des Bodens.** [The dependence of outbreaks of *Pristiphora abietina* on the water economy of the soil.]—*Allg. Forstz.* 12 no. 45 pp. 526–530, 7 figs., 13 refs. Munich, 1957.

Investigations during an outbreak of *Pristiphora abietina* (Christ) (*Lygaeonematus pini* (Retz.)) on spruce in the Black Forest, near Freiburg, showed that a suitable water content of the soil and a soil covering of fallen needles had facilitated the increase, in addition to favourable weather. The larvae of this sawfly overwinter in cocoons in the soil, and cocoons were most numerous in areas covered with needles and in which the soil was not too damp. In an experiment with soil in pots, the percentage of larvae that

gave rise to adults rose as the moisture content was increased to 70 per cent. and then decreased sharply. Acid soils were preferred by larvae seeking sites in which to spin their cocoons.

FRANZ (J.) & WELLENSTEIN (G.). **Lassen sich durch eine Frühbegiftung die natürlichen Feinde des Tannentriebwicklers *Choristoneura murinana* (Hb.) schonen?** [Can mortality of the natural enemies of *C. murinana* be minimised by early control?]  
—Z. PflKrankh. **65** pt. 1 pp. 20–32, 2 figs., 13 refs. Stuttgart, 1958. (With a summary in English.)

A test was carried out in 1956 during an outbreak of *Choristoneura murinana* (Hb.) on silver fir [*Abies alba*] in the Black Forest near Baden Baden [cf. R.A.E., A **46** 140] to find out whether, by applying insecticides against the second-instar larvae in spring at the time when they are moving from their winter quarters to the opening buds, effective control could be obtained with a minimum of detriment to the more important parasites. Of the latter [cf. **35** 72–73], some oviposit in the older larvae or in the pupae 3–4 weeks after the resumption of activity and others, comprising *Cephaloglypta* (*Glypta*) *murinanae* (Bauer) and *Apanteles* spp., oviposit in the young larvae in summer and emerge from the fifth- or sixth-instar individuals in the following year.

An area of 235 acres was treated from an aeroplane on 25th–27th April, first with an emulsion spray containing 2 per cent. trichlorphon (Dipterex) and then with a spray containing 6.7 per cent. DDT, 20 per cent. xylene as a solvent and 73.3 per cent. diesel oil at a rate of 1.53 lb. DDT per acre. A neighbouring, somewhat less heavily infested area, comprising 494 acres was dusted with a toxaphene preparation between 25th May and 3rd June, when sixth-instar larvae and prepupae predominated. The weather during and after dusting was poor. The results of treatment with toxaphene on infestation and parasitism are given for only a limited part of the total area. Infestation of buds by the young larvae before treatment in parts of this and in a neighbouring untreated control area averaged 13.7 and 13.1 per cent., respectively. Counts after treatment showed that the percentage of needles destroyed averaged 13.2 for trichlorphon and DDT and 52.1 for toxaphene, as compared with 51.9 in the control area. In various other parts of the area treated with toxaphene, in which larval development was comparatively retarded, defoliation was less than in the control area, although heavier than on trees treated with DDT. Collection of pupae from the crowns of trees in the first half of June showed that the percentages parasitised were 4.7 for DDT and trichlorphon and 2.7 for toxaphene, as compared with 23 on the control trees. It is not known whether the insecticides killed the parasites at the time they attacked the larvae or whether they did so earlier, directly or by destroying their alternative hosts. Of the parasites observed in the untreated area, *Itoplectis maculator* (F.) comprised 80.6 per cent., *Apechthis resinator* (Thnb.) 10.9 per cent., *Phaeogenes maculicornis* (Steph.) 5.5 per cent. and *Pimpla turionellae* (L.) 3 per cent. Only the first three were observed in the treated areas. The numbers of egg-masses laid by *Choristoneura* per sq. yard of branch were 1.8 on trees treated with DDT and trichlorphon, 42.4 on those dusted with toxaphene and 40.3 on untreated trees. Examination of overwintered third- and fourth-instar larvae of the following generation at the beginning of May 1957 showed that the percentage parasitised by *Cephaloglypta* and *Apanteles* spp. was 7.2 in the area treated with DDT and trichlorphon and 4.3 in the control; the difference was not significant. Toxaphene had most effect on other arthropods. The results are compared with those of somewhat similar investigations with DDT for the control of *Choristoneura fumiferana* (Clem.) in Canada [cf. **48** 142, etc.].

MARTINI (C.). **Beobachtungen über das Saugen bei Blattläusen (Homoptera Aphididae).** [Observations on the feeding of aphids.]—*Z. PflKrankh.* 65 pt. 2 pp. 90–92, 3 figs., 1 ref. Stuttgart, 1958. (With a summary in English.)

Histological investigations on the condition of the oesophagus and gut of apterous adults of *Aphis fabae* Scop., *Myzus persicae* (Sulz.) and *Rhopalosiphoninus staphyleae tulipaellus* (Theo.) reared on beet indicated that feeding by these aphids is usually continuous.

STEINER (H.) & NEUFFER (G.). **Eine netzunabhängige Insekten-Lichtfalle.** [An insect light-trap independent of mains current.]—*Z. PflKrankh.* 65 pt. 2 pp. 93–97, 6 figs., 5 refs. Stuttgart, 1958. (With a summary in English.)

Details are given of the construction of a light-trap that can be operated by a 6-volt electric battery and is thus convenient for use at a distance from buildings, propinquity to which sometimes affects the results of trapping.

BLAASEN (P.) & THIELEMANN (R.). **Zur Frage der Bekämpfung der Vergilbungs-krankheit der Beta-Rüben durch Überträgerbekämpfung mit chemischen Mitteln. II. Die Wirkung verschiedener Wirkstoffgruppen auf die Blattlauspopulation der Beta-Rüben.** [Contribution to the question of the control of virus yellows of beet by killing the vectors with chemicals. II. The effects of various groups of chemicals on the aphid population on beet.]—*Z. PflKrankh.* 65 pt. 3 pp. 129–143, 1 fig., 5 graphs, 13 refs. Stuttgart, 1958. (With a summary in English.)

In this second paper of a series [*cf. R.A.E.*, A 42 279], the detailed results are given of experiments in western Germany in 1953–56 on the effectiveness of spraying with insecticides in preventing the spread of the yellows disease of beet by its aphid vectors. The insecticides tested comprised demeton (Systox) and methyl-demeton (Metasystox), which are systemic in effect, parathion, Chlorthion, malathion, diazinon with the addition of BHC, BHC itself, and a mixture of  $\gamma$  BHC (lindane) and dieldrin, and they were evaluated for both immediate and lasting control. The aphids concerned were *Aphis (Doralis) fabae* Scop. and *Myzus (Myzodes) persicae* (Sulz.). It is stated in the authors' summary of the findings that the systemic insecticides were the most effective in reducing infestation by the aphids. Parathion was the best of the other materials, but all of these had some effect except BHC, which had hardly any. Alates were little affected by spraying. Differences in performance of the various compounds and the importance of experimental design for such investigations are discussed.

STÜBEN (M.). **Beobachtungen über den Einfluss der Beleuchtung mit Leuchtstoffröhren auf die Verhinderung der Winterruhe bei *Piesma quadratum* (Fieb.).** [Observations on the effect of illumination with luminous tubes in preventing hibernation in *P. quadratum*.]—*Z. PflKrankh.* 65 pt. 4 pp. 211–214, 1 graph, 5 refs. Stuttgart, 1958. (With a summary in English.)

*Piesma quadratum* (Fieb.) leaves beet fields in August or September in search of hibernation quarters at the edges of woods, although food is still

abundant and temperature within the range favourable for activity [cf. *R.A.E.*, A 46 67]. The winter rest can be interrupted as early as December by high temperature and occasional illumination. Since it seemed that development might be continuous under favourable conditions of light, the Tingid was reared on beet seedlings in the laboratory under a light intensity of 200–220 lux provided by luminous tubes, at a temperature averaging 20–22°C. [68–71.6°F.]. Development continued through the winter, and the adults that emerged oviposited in early summer without hibernating.

RICHTER (G.). **Die Maikäferpopulationen im Gebiete der Deutschen Demokratischen Republik.** [*Melolontha* populations in the territory of the German Democratic Republic.]—*NachrBl. dtsh. PflSchDienst* (N.F.) 12 pt. 2 pp. 21–35, 4 figs., 31 refs. Berlin, 1958. (With summaries in English & Russian.)

As the last comprehensive survey of the distribution of *Melolontha* spp. in Germany was that of Schmidt in 1925 [*R.A.E.*, A 13 438] and considerable changes appeared to have taken place since the war in the flight years and injuriousness of these cockchafer, a further survey was carried out in eastern Germany, by means of questionnaires, scrutiny of local records and personal observations. The results are given in detail for the 14 administrative regions into which the territory is divided, and they are discussed in relation to the earlier information. The principal species present is *M. melolontha* (L.), and both it and *M. hippocastani* F. normally have a four-year life-cycle in this area. The distribution of infestation and the flight years (expressed in relation to leap years) in 1950–57 are shown on a map. It was found that infestation occurred in 10 per cent. of all localities and that, whereas the principal flight years of both species recurred regularly every four years in many of them, the period between those of *M. melolontha* appeared to be reduced from time to time to three years, among a part or the whole of the population, in others. In areas to the west of Leipzig and Magdeburg, to the south of Leipzig and near Angermünde (to the north-east of Berlin), the main flight years had changed, since about 1914–23, from the second to the first year after each leap year near Angermünde and from the third to the second in the other areas. Around and to the east of Dresden and in parts of Mecklenburg, considerable flights occurred in successive years, indicating that a proportion of the adults occasionally emerged after three years. In much of the area to the south of the Harz, in the Thuringian forest, in the area to the south-east of Dresden and in that between Neustrelitz and Ruppín in the north, the main flight occurred regularly every leap year, and in north-western Mecklenburg and an area near Potsdam infested solely by *M. hippocastani*, it occurred two years and one year after leap years, respectively. An alteration in the normal period between the main flight years of *M. melolontha* appeared to have occurred only in regions where an average annual maximum temperature of 12.6°C. [54.68°F.] was reached or exceeded. Infestation was generally heaviest in areas in which there was an occasional shortening of the period between main flight years, rather lower where the period did not vary, and lowest where there was a partial shortening and flights were more frequent but less intense. It is considered, however, that climate alone cannot account for the constantly low populations in some localities and the regularity of the main flight years in others. Other factors are doubtless involved, and destruction of the adults by birds is probably of some importance, since it has proportionately more effect on smaller beetle populations and tends to eliminate those that emerge in other than the main flight years.

DLABOLA (J.). *Calligypona pellucida* Fabr.—ein Haferschädling und eventueller Vektor einer Getreidevirose. [*Calligypona pellucida*—a pest of oats and a possible vector of a cereal virus.].—*NachrBl. dtsh. PflSchDienst* (N.F.) 12 pt. 2 pp. 36–38, 5 figs., 2 refs. Berlin, 1958. (With summaries in English & Russian.)

A disease of oats observed in recent years in south-eastern Bohemia and northern Slovakia was found to be due to infestation by *Calligypona* (*Delphacodes*) *pellucida* (F.) [cf. R.A.E., A 47 407, etc.], and a toxic secretion of the insect or a virus transmitted by it appeared to be involved. Damage was severe in 1956, when large areas were affected and all the oats were attacked in some places. The older nymphs of the Delphacid overwinter in grassy sites and at the edges of woods. Infestation first appears on the plants at the beginning of May, when numbers are not, however, always very great, and considerable populations are present in late summer. The females oviposit in the leaf blades, and both adults and nymphs feed on the plants. Plant development is normal until the end of June, when growth suddenly becomes inhibited and yellow stripes appear on the leaves, which later become yellow, reddish or reddish-violet. Severely affected plants produced numerous tillers but later died, and few produced ears. The same symptoms were observed on wheat growing near affected oats, some plants attacked being only a third to half as tall as normal ones. In tests in which *C. pellucida* was collected from oats in south-eastern Bohemia in the autumn of 1956 and allowed to feed on healthy oats in pots for 6 days, or even one individual was left on a plant for one day, growth became inhibited and the plants were only half as large after two weeks as uninfested ones kept in the same way. Females caused rather more inhibition of growth than did males, probably as a result of oviposition. The symptoms were also produced on oats by *C. pellucida* collected from lucerne fields and other habitats outside the areas in which oats were infested. In other tests, they were produced on wheat, barley and rye, but only by nymphs that had hatched from eggs deposited on diseased oats, and were severe on wheat but slight on the other plants.

MAASSEN (H.). *Acyrtosiphon pelargonii* ssp. *rogersii* Theob. als Vektor von Erdbeerviren in Mitteldeutschland. [*Macrosiphum malvae* subsp. *rogersii* as a vector of strawberry viruses in central Germany.].—*NachrBl. dtsh. PflSchDienst* (N.F.) 12 pt. 2 pp. 39–40, 1 fig., 6 refs. Berlin, 1958.

Of the aphids known to transmit strawberry viruses, *Macrosiphum* (*Acyrtosiphon*) *malvae* (*pelargonii*) subsp. *rogersii* Theob., which is briefly described, is sometimes quite numerous in central Germany and has experimentally transmitted strawberry viruses to wild strawberry (*Fragaria vesca*) there. In one test, the aphids were allowed to feed for 24 hours on an infected strawberry plant that had shown chlorotic spots during summer but no symptoms at other times, after which 25 individuals were kept for a further 24 hours on a healthy plant of *F. vesca*. A slight curling of the youngest leaf was observed on the latter after 15 days, and the leaves later became slightly deformed and showed chlorotic spots, which were most numerous at the edges. The virus was not identified. It is concluded that the aphid is probably of some importance as a vector in central Germany, particularly since the best-known vector of strawberry viruses, *Capitophorus* (*Pentatrachopus*) *fragaefolii* (Ckll.), apparently does not occur there.

HEROLD (F.) & BREMER (H.). **Untersuchungen zur Epidemiologie, Ökologie und Bekämpfung des Gurkenmosaikvirus.** [Investigations on the epidemiology, ecology and control of cucumber-mosaic virus.]—*Gartenbauwissenschaft* 23 (5) pt. 2 pp. 254–274, 10 figs., 31 refs. Munich, 1958. (With a summary in English.)

Cucumber mosaic, the symptoms of which are described, is common on cucumbers grown for pickling in western Germany. There is no correlation between the occurrence of the virus and that of its aphid vectors, and, of the latter, *Aphis fabae* Scop. was sometimes so numerous as to cause severe damage to the plants even without transmission of virus.

DE LOTTO (G.). **The Pseudococcidae (Hom.: Coccoidea) described by H. C. James from East Africa.**—*Bull. Brit. Mus. (nat. Hist.) Ent.* 5 no. 5 pp. 183–232, 24 figs., 14 refs. London, 1957.

WILLIAMS (D. J.). **The mealy-bugs (Pseudococcidae: Homoptera) described by W. M. Maskell, R. Newstead, T. D. A. Cockerell and E. E. Green from the Ethiopian Region.**—*Op. cit.* 6 no. 8 pp. 203–236, 10 figs., 20 refs. 1958.

WILLIAMS (D. J.). **The mealy-bugs (Pseudococcidae: Homoptera) described by W. J. Hall, F. Laing and A. H. Strickland from the Ethiopian Region.**—*Op. cit.* 7 no. 1 pp. 1–37, 15 figs., 16 refs. 1958.

DE LOTTO (G.). **The Pseudococcidae (Hom.: Coccoidea) described by C. K. Brain from South Africa.**—*T.c.* no. 3 pp. 77–120, 19 figs., 17 refs.

These are the first of a proposed series of papers in which the mealybugs of Africa south of the Sahara are to be revised and very many of them redescribed and illustrated. The species are grouped according to their authors. The series is to be concluded by a generic revision, and the generic classification adopted is therefore only provisional. Williams arranges the species in genera in current usage, whereas De Lotto cites them in the genera in which they were originally described. Information on synonymy and the original records of the mealybugs are given by both authors. Changes in nomenclature that affect species mentioned in this Review include *Dysmicoccus brevipes* (Ckll.) (*Pseudococcus longirostralis* James) and *Trionymus sanguineus* James (*panici* James), in the first paper; *Nipaecoccus vastator* (Mask.) (*Trionymus sericeus* James, *P. filamentosus* var. *corymbatus* Green), *D. brevipes* (*P. cannae* Green) and *Paraputo* (*Ripersia*) *anomala* (Newst.) (*P. ritchei* Laing), in the second; *Paracoccus* (*Pseudococcus*) *proteae* (Hall), *Planococcoides* (*Pseudococcus*) *njalensis* (Laing), *Pseudococcus hargreavesi* Laing (*bukobensis* Laing), *Planococcus* (*Pseudococcus*) *celtis* (Strickl.) and *Rhizoecus* (*Coccidella*) *spelaeus* (Strickl.), in the third; and *Antonina natalensis* Brain (*indica panica* Hall) and *Paracoccus* (*Pseudococcus*) *burnerae* (Brain) (*Pseudococcus simulator* James), in the fourth.

WHALLEY (P. E. S.). **The use of dieldrin for control of carpenter bees (*Xylocopa* sp.).**—*E. Afr. agric. J.* 24 no. 1 p. 16. Nairobi, 1958.

Bees of the genus *Xylocopa* cause considerable damage by tunnelling in timber in Uganda; unpainted wood is most usually affected, though some damage was found in painted wood, and the rafters of buildings are particularly susceptible. In experiments on the value of dieldrin for control, the rafters projecting from two houses were thoroughly sprayed once or

twice with wettable dieldrin at 1 per cent. and the rafters round the laboratory with the same at 1, 0.5 and 0.25 per cent. A concentration of 1 per cent. gave protection for at least ten months, and 0.5 per cent. for over six months.

LLOYD (J. H.). **Locust control by aircraft in Central and East Africa.**—*E. Afr. agric. J.* **24** no. 1 pp. 26–32, 40 refs. Nairobi, 1958.

This account of the development of methods and techniques and of the aircraft employed for the control of locusts from the air is based on the literature, unpublished reports and work that was to be published in greater detail elsewhere. It relates primarily to *Nomadacris septemfasciata* (Serv.) in its outbreak area in the Rukwa Valley, Tanganyika, [cf. *R.A.E.*, A **37** 133], but reference is made to work on other species and in other parts of the world [cf. **37** 313; **38** 480; **39** 97, 393; **42** 125, 418; **45** 318].

DROUILLON (R.). **La leçon de deux campagnes de désinsectisation dans les plantations de caféiers de l'Oubangui-Chari.**—*Agron. trop.* **14** no. 2 pp. 198–207. Paris, 1959. (With summaries in English & Spanish.)

Details are given of large-scale operations in Oubangui-Chari (French Equatorial Africa) in 1957–58 in which atomised emulsion sprays of endrin were applied by modern machinery for the control of *Stephanoderes hampei* (Ferr.) on coffee. The results were very satisfactory, the percentage of damaged berries in commercial samples being reduced from 15 to 3.4 in 1957, and the area under the crop was extended in 1958. About 0.675–0.72 lb. actual chemical per acre was required.

COHIC (F.). ***Dialeurodicus elongatus* Dumbleton, aleurode parasite du cocotier en Nouvelle-Calédonie.**—*Agron. trop.* **14** no. 2 pp. 232–238. 31 figs., 7 refs. Paris, 1959. (With summaries in English & Spanish.)  
**Aleyrodidae actuellement connus de Nouvelle-Calédonie et dépendances.**—*T. c.* pp. 242–243, 7 refs.

It is stated in the first of these papers that *Dialeurodicus elongatus* Dumbleton, all stages of which are described, infests coconut and other introduced palms in New Caledonia; it has also been recorded in the Loyalty Islands. The eggs are laid and the larvae develop on the lower surfaces of the leaflets, and the Aleyrodid is sometimes accompanied by two Coccids, *Aspidiotus hederæ* (Vall.) and *Chrysomphalus ficus* Ashm. Combined infestation by these three severely damages young palms, but older ones are more resistant. *D. elongatus* is commonest in October–April, development being retarded in the cool season from May to September. Control can be effected by cutting out and burning infested palms and, on young palms, by spraying with parathion or nicotine sulphate in oil emulsion, which also controls the Coccids.

In the second paper, 12 Aleyrodids, with their food-plants, are recorded from New Caledonia and its dependencies.

ANDRÉ (M.). ***Brevipalpus australis* (Tucker), parasite des orangers (*Citrus aurantium* L.), du Sénégal.**—*Agron. trop.* **14** no. 2 pp. 239–241, 2 figs., 8 refs. Paris, 1959.

*Brevipalpus californicus* (Banks) (*australis* (Tucker)) [cf. *R.A.E.*, A **48** 150] is recorded on *Citrus* in Senegal, and its identity, distribution and food-plants are reviewed.

RÉAL (P.). **Le cycle annuel de la cochenille *Dysmicoccus brevipes* Ckll., vectrice d'un "wilt" de l'ananas en basse Côte d'Ivoire; son déterminisme.**—*Rev. Path. vég.* 38 fasc. 1 pp. 3-111, 54 figs., 56 refs. Paris, 1959. (With a summary in English.)

Pineapple wilt, caused by *Dysmicoccus brevipes* (Ckll.), occurs in the lower Ivory Coast, and investigations were carried out in 1956-58 on the seasonal occurrence of the condition, on changes in the population density of the mealybug and on its control. The symptoms of wilt are described, the climatic factors favouring its onset, mainly insolation, are discussed, and it is pointed out that symptoms appear most rapidly after feeding by *D. brevipes* in April and August. In the laboratory, the females become sexually mature in 48 days, oviposit for about 18 days, and die 3-5 days later. The oviposition rate reaches a maximum of about 100 eggs per day on the 6th-11th day of maturity; there are indications that parthenogenesis sometimes occurs. Length of life is governed by factors within the plant, principally the sugar content, and varies according to the part infested. There was little correlation between the laboratory findings and field observations, except as regards fecundity. In the field, the life-cycle probably lasts only 40 days; numbers increase with successive generations for about 90 days, after which ants transport part of the population to another site. In March, first-stage nymphs and immature females appear unable to withstand adverse influences of climate or competition and populations decrease rapidly, leaving a preponderance of second-stage nymphs that can withstand such conditions. The term 'demostasis' is proposed for this condition. An opposite phase, termed 'demophase', occurs in some populations between late October and mid-January, when, with temperatures of 30.5-31.5°C. [86.9-88.7°F.] and a relative humidity of 61.5-64.5 per cent., young colonies become tolerant of crowding and increase rapidly, overwhelming longer-established infestations that developed more slowly. The sex ratio is usually two males to one female, but males appear to be absent during a period of demostasis and their number increases tenfold when the population is in a state of demophase. Populations normally double with each generation, but the increase is up to sixfold in demophase, when a single female may produce 300-400 progeny.

The influences of temperature and relative humidity (combined to give units in hygrothermic degrees [cf. *R.A.E.*, A 44 343]), irrigation, sunlight, wind and transport by ants on the ecology of the mealybug are considered. Ecological factors alone do not wholly explain such aspects in its biology as the onset of demophase or a slight increase in fecundity prior to death, but temperature and humidity are shown to play an important part and can be used to give a measure of the potential importance of an outbreak and of the probable appearance of wilt, so that control measures can be planned in advance. Ant activity is the major adverse factor in such plans, since it cannot be forecast. Infestation of pineapples usually occurs in the transition periods of April-May and October-January, but sometimes begins in the dry season if this is not too marked.

Control of an outbreak is not necessary until the mealybugs reach the second generation. Measures are therefore required in late February, early September and late October, against the three main invasions, but the generations frequently overlap to such an extent that subsidiary treatments are also required in late January, mid-August and late September, and two further applications in early and late June may be needed to control outbreaks before the onset of the short dry season in July. Populations on individual plants are very variable in the absence of ants, adjacent plants bearing 1 and 30,000 mealybugs having been observed, and measures

to prevent the distribution of *D. brevipipes* within a plantation by ants are therefore of more importance than those against the mealybug itself.

The ants found transporting *D. brevipipes* were species of *Camponotus*, *Crematogaster* and *Pheidole*. *Camponotus* nests in the soil and *Crematogaster* in trees, and all three move about within the soil at depths of 4–12 in. and are therefore protected from normal methods of control. In preliminary tests, a planting was intersected by ditches cut 10–25 ft. apart and 1 ft. deep in July. The sides of the ditches and the soil removed were dusted with a mixture of two parts BHC and one part DDT (10 per cent. active ingredient) at a rate of about 10 oz. per 3 yards, and the ditches then were refilled. Pineapple slips were disinfested by dipping in 0.02–0.04 per cent. parathion and then planted at 3-ft. intervals. Complete protection was given for five months, but ants then entered the area, probably mostly by flight. In further tests begun in late 1956 or early 1957 in an irregularly ditched area, in which the ditches were dusted with 2 or 25 per cent. dieldrin or the mixture of BHC and DDT, the planting material was disinfested with parathion and each planting hole was dusted with 2 per cent. parathion, no wilt had occurred by May 1958, and 0.02 per cent. parathion was applied in February–May 1958 with the routine fruit-setting hormones as a further precaution. A long-term experiment was begun in the Adiopodoumé peninsula, in which a newly established plantation was divided into 33-ft. squares by ditches treated with SPC [polychlorocyclohexane sulphide] and plants in selected squares were artificially infested on various dates. A few plants became infested, but the ditches were still effective after 18 months in restricting the spread of wilt. Such measures are of value in preventing infestation, but direct control of the mealybug is recommended against established populations.

HARRIS (K. M.). **Notes on gall midges (Cecidomyiidae) on Nigerian crops with a description of a new species of *Thomasiella* Rübsaamen.**—*Bull. ent. Res.* 50 pt. 4 pp. 661–666, 1 pl., 3 figs., 6 refs. London, 1960.

*Thomasiella sorghivora*, sp.n. is described from adults of both sexes, larvae and pupae reared from sorghum in October 1956 at a place in Northern Nigeria. This Cecidomyiid, which appeared in the same place again in 1957 and 1958 and is known from several others in Northern Nigeria and one in Western Nigeria, attacks the crop in September and October, when colonies of larvae excavate galleries in the upper internodes of the flowering stem, usually just above a node. Pupation takes place in the stem, but ceases during November; the remaining larvae become inactive and overwinter in the stems, which, since they are usually stored after harvest for use as building material or fuel, provide an important source of infestation for the next crop. The adults emerge from the stems, leaving holes through which the empty pupal cases protrude. Many infested stems are lodged at harvest in November. In 1958, damage was moderate at two places and severe over an acre at a third.

The paper also includes information on the occurrence of two other Cecidomyiids in Northern Nigeria. *Pachydiplosis oryzae* (Wood-Mason) was reared from rice in October 1956 and was collected in subsequent years at the same place, where it was not very injurious, and one other. In 1958, it appeared in late July and early August; almost every plant was attacked in one field in early August, but a month later the plants were growing strongly and few galls could be found. *P. oryzae* is not expected to be a major pest where the rice is well grown and only one crop is cultivated each season, but may be of local importance where there is more than one

crop or in poor seasons. *Asphondylia sesami* Felt was reared from benniseed (*Sesamum orientale*) at one place in October 1956 and another in August 1958, and is also known from two other places in the Province. Infestation was severe in experimental plots, especially where series of different sowings were made or several varieties were cultivated, and farmers' late-sown crops at one place were damaged in some years. The plants are usually attacked in July and August, when in flower, but galled capsules containing larvae and pupae were collected on late-sown crops in October and November. When young flowers are attacked, the developing capsules become swollen, distorted and useless, but when the capsule is attacked later in its development, the gall is restricted to part of one loculus and seed may be set in others. Each gall contains one larva, but there may be several galls on one loculus. Pupation takes place within the gall. Hymenoptera were reared in large numbers from the galls, and natural parasitism may be high; five possible parasites of *A. sesami* obtained in this way included *Neanastatus africanus* Ferrière and *Eurytoma* sp.

EADY (R. D.). **A new genus and two new species of Encyrtidae (Hymenoptera, Chalcidoidea) from the banana scab moth, *Nacoleia octasema* (Meyr.).**—*Bull. ent. Res.* 50 pt. 4 pp. 667–670, 11 figs., 5 refs. London, 1960.

Two new Encyrtids were reared from the banana scab moth, *Nacoleia octasema* (Meyr.), in New Guinea in 1957. One of them, an important primary, and apparently polyembryonic, parasite of the larvae, belongs to a new genus close to *Copidosoma* and *Litomastix* for which the name *Pseudolitomastix*, n., is proposed\*; it is described from adults of both sexes as *P. nacoleiae*, sp. n. The other, which is also described from both sexes, is *Tyndarichus clavatus*, sp. n., which is a hyperparasite of *N. octasema* and was reared from *P. nacoleiae*.

CASWELL (G. H.). **Observations on an abnormal form of *Callosobruchus maculatus* (F.).**—*Bull. ent. Res.* 50 pt. 4 pp. 671–680, 3 figs., 5 refs. London, 1960.

The following is taken almost entirely from the author's summary. Under certain conditions, *Callosobruchus maculatus* (F.) produces males and females that are distinct from the normal ones [cf. *R.A.E.*, A 46 213; 47 389, 452], and these adults, which are here referred to as the active form, were investigated in the laboratory in southern Nigeria. The pre-adult stages were found to last rather longer (32–36 days) than those of the normal form (25–30 days). There was some evidence that a genetic factor is concerned in the production of the active form [cf. 47 389], but no clear indication as to what external factors are involved. The normal female has mature eggs in its calyces within a day of emergence, and will lay about 60 eggs. The active female was found to have immature ovaries on emergence, and these did not develop to any great extent in the conditions employed. About three-quarters of the active females did not produce eggs, and the rest produced an average of seven. This difference in egg-production probably makes food reserves available, which are used to prolong the life of the active female. The eggs laid by active females were rarely fertile, but such as were gave rise to apparently normal males and females.

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\* We are informed by the author that a new name will be proposed for this genus, since the name selected is preoccupied by *Pseudolitomastix* Risbec (1954).—Ed.

PREVETT (P. F.). **A study of rice storage under tropical conditions.**—*J. agric. Engng Res.* 4 no. 3 pp. 243–254, 12 figs., 8 refs. Silsoe, Beds., 1959. (With summaries in French & German.) **The oviposition and duration of life of a small strain of the rice weevil, *Calandra oryzae* (L.), in Sierra Leone.**—*Bull. ent. Res.* 50 pt. 4 pp. 697–702, 3 graphs, 11 refs. London, 1960.

In the first paper, the author describes a study of problems of infestation of stored rice carried out in Sierra Leone in 1955–58, and the following is almost entirely his summary of the work. Records were kept of the ambient conditions and of the temperature and moisture in stacks of bagged raw and parboiled rice contained in a corrugated iron store for a year, and in native cleaned rice (hand-pounded native parboiled paddy) stored in bulk in a cylindrical plywood silo for a similar period. Temperatures within the raw-rice stack, which was lightly infested by *Calandra oryzae* (L.), *Rhizopertha dominica* (F.), *Cryptolestes pusillus* (Schönh.) and *C. ferrugineus* (Steph.), showed a fairly close correlation with the trend in ambient conditions, whilst heavy infestation of the parboiled rice by *Calandra oryzae* and, more especially, by *R. dominica*, to which it is very susceptible, resulted in considerable increases in temperature. Ambient conditions influenced temperature trends throughout, and the high temperatures that were recorded in the plywood silo, where the rice was infested on the surface by *Tribolium castaneum* (Hbst.), were largely the result of extreme ambient conditions during the early part of the storage period. Such conditions are likely to be detrimental to the quality of the rice. Damp mouldy rice was caked to a large part of the wall after discharge, indicating that translocation of water vapour had taken place and suggesting a temperature gradient from the central column of rice to the periphery.

In the course of this work, laboratory studies of certain pests were made, and the second paper contains an account of investigations on the small strain of *C. oryzae*, for which the name *C. sasakii* Tak. has recently been adopted [cf. *R.A.E.*, A 48 130, etc.]. The following is based almost entirely on the author's summary of the results. The rate of oviposition of individuals reared on parboiled milled rice and their utilisation of grains for oviposition were studied under normal laboratory conditions in Sierra Leone (means of 27°C. [80.6°F.] and 80 per cent. relative humidity). On the average, a female laid 68 eggs in all [cf. 30 8], over an oviposition period of 71 days, the peak of egg-laying being reached during the third week. Only 13 per cent. of the ten grains with which each pair was confined were used for oviposition. Differences between these results and those recorded by other workers [cf. 34 223; 40 272; 41 17] are discussed. The mean length of life of males and females was found to be 113 and 97 days, respectively.

SMITH (K. G.). **Insect infestation associated with French shelled walnuts with particular reference to the occurrence of *Aphomia gularis* (Zell.) (Lep., Galleriidae).**—*Bull. ent. Res.* 50 pt. 4 pp. 711–716, 1 fig., 3 refs. London, 1960.

The following is substantially the author's summary. Walnuts grown and shelled in the Dordogne and adjacent regions of France are exported to Britain and other countries. The inspection of cargoes arriving at Liverpool between July 1955 and July 1958 showed that they may frequently be infested by a number of insect pests. Of the 20 species recorded, six occurred regularly. These were *Oryzaephilus surinamensis* (L.), *Aphomia gularis* (Zell.), *Plodia interpunctella* (Hb.), *Cryptophagus subfumatus* Kraatz,

*Nemapogon granella* (L.) and *Enarmonia* sp., of which the last three were the least abundant. During that period, changes occurred in the levels of infestation and the relative abundance of the species. In particular, there was a considerable increase in the occurrence of *O. surinamensis*. Though the general levels of infestation were light, parts of 58 per cent. of the cargoes had to be fumigated to prevent pests being distributed to factories, bakeries and shops in Britain and on parcels transhipped to other countries. Though many of the species found are already established in those countries where conditions are suitable for their development, some still are limited in their distribution. These include *A. gularis* [cf. *R.A.E.*, A 45 60], a serious pest of nuts, dried fruit and cereals. If the further spread of this and the other pests is to be prevented, there is need for a more general application of control measures in the country of origin, with strict control and possibly fumigation of cargoes before shipment.

FERNANDO (H. E.). **The susceptibility of the rice Pentatomid bug, *Scotinophara lurida* (Burm.), to insecticides, and the insecticidal control of this pest in Ceylon.**—*Bull. ent. Res.* 50 pt. 4 pp. 717–735, 3 graphs, 7 refs. London, 1960.

The following is substantially the author's summary. *Scotinophara lurida* (Burm.) is a serious pest of rice in certain areas of Ceylon. Several generations develop on the two annual crops, and the one that attains the adult stage at the time of harvest of either aestivates and does not become sexually mature until later. The generations that become adult earlier in each crop season become sexually mature forthwith, and mate and oviposit. Laboratory experiments to ascertain the susceptibility of adults of the Pentatomid to modern insecticides and field experiments on control were begun in 1952. In the laboratory, ten insecticides were tested. Bugs that were freshly emerged, sexually mature or aestivating were treated by topical application of acetone solutions to the abdomen, and it was found that the order of decreasing toxicity, based on the LD<sub>50</sub>, to the sexually mature adults was  $\gamma$  BHC, endrin, dieldrin, parathion, trichlorphon (Dipterex), Chlorthion, diazinon, Guthion, malathion and DDT. The adults of the aestivating generations, at least prior to becoming sexually mature, were markedly more resistant to all the insecticides than were sexually mature bugs of uninterrupted development, the resistance ranging from twofold to 19-fold that of the latter. There was some indication that tolerance to insecticides does not necessarily increase with increasing age and sexual maturity of the normal adult. Thus, whereas the organophosphorus insecticides became less effective with increasing sexual maturity, with DDT and endrin the bugs appeared to become more susceptible as maturity progressed, and with  $\gamma$  BHC and dieldrin there was little change.

In the field tests, 14 insecticides were compared in emulsion sprays. DDT and chlordane were slow in action, a concentration of about 0.45 per cent. or more resulting in only about 85 per cent. mortality in 24 hours; toxaphene was still less effective. Aldrin and isodrin at 0.06 per cent. gave about 90 per cent. kill in 24 hours. The other materials gave complete or almost complete mortality in that period, the minimum concentrations required being 0.02 per cent. for parathion or Guthion, 0.03 per cent. for endrin or Chlorthion, 0.03–0.04 per cent. for trichlorphon, 0.06 per cent. for dieldrin, malathion or  $\gamma$  BHC and 0.07 per cent. for diazinon. Of the dusts tested,  $\gamma$  BHC at 1.3 per cent. and dieldrin at 2.5 per cent. gave complete control in 24 hours when applied under the still and dewy conditions obtaining in the morning. Under dry, windy conditions,  $\gamma$  BHC at 1.3 and 3 per

cent. gave better control than did dieldrin or aldrin. Parathion, dieldrin, endrin, methyl-demeton (Metasystox) and thiometon (Ekatin) were tested for persistent action. Parathion left the most effective residue, which was toxic for a period of two days, followed by dieldrin. Methyl-demeton and thiometon were tested as foliar sprays and as root treatments for their systemic action in rice plants three and ten weeks old. Systemic action of a low order was demonstrated in all cases, but the poor results achieved and the high rates of application involved did not warrant practical field use.

BENNETT (F. D.). **Parasites of *Ancylostomia stercorea* (Zell.), (Pyralidae, Lepidoptera) a pod borer attacking pigeon pea in Trinidad.**—*Bull. ent. Res.* 50 pt. 4 pp. 737–757, 6 figs., 23 refs. London, 1960.

Insect pests of pigeon pea (*Cajanus cajan*) were investigated in Trinidad in 1952–54 with a view to the introduction of suitable parasites into Mauritius for the control of *Etiella zinckenella* (Treitschke) and *Maruca testulalis* (Geyer) on the same crop, and the following is partly based on the author's summary of the work. The only important pod borer attacking the crop in Trinidad is *Ancylostomia stercorea* (Zell.), which breeds throughout the year. Eggs are laid on the young pods, and the larvae feed on the developing seeds and pupate in the soil, the complete life-cycle lasting 26–32 days. No egg parasites were found, but four Braconids [cf. *R.A.E.*, A 45 345], an Ichneumonid, a Bethyid, an unidentified Tachinid and a Mermithid were reared from the larvae, and information is given on the bionomics of the first six, together with descriptions of all stages and notes on rearing techniques. Of the Braconids, *Apanteles etiellae* subsp. *isolatus* Mues. is a solitary endoparasite that attacks the larvae in the first three instars. The larva leaves the fourth-instar host after consuming its body contents and pupates in a cocoon in the pod. The life-cycle occupies 14–18 days. The egg of *Phanerotoma bennetti* Mues. is laid in that of the host, but the parasite does not complete its development until the host has reached the last larval instar and constructed its cocoon. A generation is completed in 20–28 days. Owing to heavy mortality among the small host larvae, it was difficult to rear this parasite on *Ancylostomia*, and a method devised for rearing it on *Ephestia cautella* (Wlk.) is described; on this host, which develops more slowly, the life-cycle lasted 40–50 days. *Bracon thurberiphae* (Mues.) and *B. cajani* Mues. are gregarious ectoparasites of similar habits. They paralyse host larvae in the second to fifth instars and deposit eggs on or near them. The life-cycle is completed in 13–16 days. These two parasites could not be reared on a large scale in the laboratory, because mated females failed to oviposit satisfactorily, but large numbers were obtained from field-parasitised larvae, which were kept, two or three together, in small glass vials from which the parasite cocoons were eventually removed. The Ichneumonid, *Eiphosoma annulatum* Cress., is a solitary endoparasite that attacks its hosts in the first four instars. The parasite larva leaves the fifth-instar host, which may be stunted but constructs a normal cocoon, and the parasite pupates in a cocoon within that of its host, the life-cycle being completed in 26–35 days. *Perisierola* sp., the Bethyid, is a gregarious ectoparasite. The female enters a pod and oviposits directly on the host larva after first paralysing it. Hosts may be attacked in any instar from the second to the fifth, but the larger ones are preferred. Development lasts 11–15 days, during which the female frequently remains with its progeny. Six hyperparasites reared from cocoons of *Apanteles* or *Bracon* spp. are listed. *Horismenus* sp., *H. floridanus* (Ashm.) and *Eupelmus* sp. were reared from most collections, but hyperparasitism was low.

Details of a shipping container and the methods adopted for rearing and shipping parasites to Mauritius are described. From a stock of more than 44,000 cocoons of all six species forwarded in March–November 1953, *Bracon cajani* and *Eiphosoma annulatum* became established [cf. 46 421], the former being recorded annually from several localities and the latter in 1957 from one area.

WALKER (P. T.). **Insecticide studies on East African agricultural pests.**

**III. Seed dressings for the control of the bean fly, *Melanagromyza phaseoli* (Coq.), in Tanganyika.**—*Bull. ent. Res.* 50 pt. 4 pp. 781–793, 2 graphs, 8 refs. London, 1960.

In this third part of a series on the control of crop pests in East Africa [cf. *R.A.E.*, A 45 316], the author describes tests of seed dressings against *Melanagromyza phaseoli* (Coq.), the larvae of which mine the stems of beans and are injurious to this crop in most years in Tanganyika. The following is substantially his summary of the results. Field trials in 1956 on haricot-type beans showed that dressing the seed with chlorinated-hydrocarbon insecticides would prevent attack for at least 30 days after germination; organophosphorus compounds were less effective. In further field trials, in 1957, the insecticides and types of formulation used were aldrin as a wettable powder and an emulsion concentrate, endrin as an emulsion concentrate,  $\gamma$  BHC and dieldrin as dusts and emulsion concentrates, and a proprietary systemic organophosphorus dust (V.P. 2823) of unknown composition. Wet dressings were applied by treating the seeds with the liquid and drying immediately, and in one treatment aldrin as a wettable powder was applied dry and the seeds then damped and dried at once. Damage was assessed on an arbitrary scale in two of the trials, and yields were measured in one of these and two others. The results varied with the insecticides and the growing conditions, but wet dressing with endrin at 213 mg. per 100 g. seed, of which about half was retained on the seeds, resulted in the least damage and the highest yield, amounting to 13.5 units compared with 8.6 for the control. All treatments, except that with the organophosphorus dust, reduced the damage significantly below that in the control. Wet dressings were usually more effective than dry dressings with the same insecticide, as regards both yield and reduction in damage. This may be associated with better retention of wet dressings, as demonstrated by chemical analysis of the residues on the seeds left in the hopper after sowing.

CARDEN (P. W.). **The control of onion fly, *Delia antiqua* (Mg.), with seed dressings.**—*Bull. ent. Res.* 50 pt. 4 pp. 795–807, 1 pl., 3 figs., 13 refs. London, 1960.

The following is based on the author's summary. Seed treatments with calomel [mercurous chloride], DDT, dieldrin and aldrin were compared for the control of *Hylemyia* (*Delia*) *antiqua* (Mg.) on onion in England in 1954–56. Excellent control and improved germination were obtained when 0.5 oz. actual dieldrin per lb. of seed [cf. *R.A.E.*, A 46 389] was applied with an adhesive, alone or with thiram. Similar results were given by 0.1 and 1.5 oz. dieldrin, but 3.2 oz. reduced germination. Aldrin at the same rates gave excellent control, but reduced germination. DDT at 1.5 oz. and 3.2 oz. gave good control [cf. 36 90, 270, 293] early in the season, but was

not sufficiently persistent and seriously reduced germination. Calomel gave little control, though it improved germination [cf. 36 90, 270, 283]. Kerosene was used as an adhesive for the dusts in 1956; although satisfactory, it was liable to reduce germination seriously when used alone, except at very low rates. Seed treated with DDT, dieldrin or aldrin could safely be stored for a month or two in unsealed, but not in sealed, containers. There was close correlation between the percentage of plants attacked and the yield per 100 plants in the original stand. For every 10 per cent. of plants killed by *H. antiqua* there was a 10 per cent. loss of the potential yield. Even where attack was heavy, comparatively few plants showed symptoms of damage at any one time, which suggests that the level of attack is frequently underestimated.

SMITHERS (C. N.). **Some recent observations on *Busscola fusca* (Fuller) (Lep., Noctuidae) in Southern Rhodesia.**—*Bull. ent. Res.* 50 pt. 4 pp. 809–819, 7 refs. London, 1960.

The following is based almost entirely on the author's summary. *Busseola fusca* (Fuller) is the most injurious pest of maize in Southern Rhodesia, and its life-history and seasonal cycle [cf. *R.A.E.*, A 46 39] were studied there in 1955–57. There are two generations in the year; the full-grown larvae of the second mostly enter diapause, in which condition they pass the dry season in the maize stems, but some are short-cycle individuals that give rise to moths irregularly during the dry season. In the field, the egg stage lasts about 7–11 days, according to the season. In the laboratory, there are six and very occasionally seven larval instars in the first generation, occupying about 37 days, and the pupal stage lasts about 17 days. In the second (diapausing) generation, there may be one or two additional moults without appreciable change in size, and there is considerable variation in the duration of instars and in the date of entry into diapause, but by mid-June the bulk of the larvae that will survive are in diapause. Most diapause larvae pupate in early November, the pupal stage lasting about 23 days. The feeding habits of the larvae are described. Other recorded food-plants include *Pennisetum purpureum*, on which, however, the common borer is *B. phaia* Bowden [44 465]; the larvae of this species, which has not been recorded from maize, are indistinguishable from those of *B. fusca*.

The survival period of the adults of *B. fusca* under cage conditions averaged 6–7 days, but there was great variation. When provided with diluted honey, adults were not observed to feed, and absence of such food did not appear to impair egg-laying. The sex ratio was 1:1, but in catches at a light-trap the ratio of males to females was 5:1. Pairing takes place shortly after emergence, and oviposition may begin within 24 hours. The average number of eggs laid per female in cages was 360 over an average of four days, one female laying 1,032. Several batches of eggs may be laid in one night. A single mating appears to be sufficient, but males may pair with more than one female. Eggs laid by unmated females did not hatch.

Diapause is thought to be induced by larval feeding on drying food. Continuous rearing of non-diapause generations can be achieved by feeding the larvae on fresh green maize. Similarly, in the field, irrigated out-of-season maize will support non-diapause generations and constitute a source of infestation that may render ineffectual the normal routine destruction of all plants of the previous dry-land farming season. The main parasite is the Tachinid, *Sturmiopsis parasitica* (Curr.), which may destroy more than 33 per cent. of the larvae in either generation.

HAGNAUER (W.) & SHOEB (A.). **Phosphamidon, a new phosphorous compound against cotton pests.**—*Bull. Soc. ent. Egypte* 42 pp. 63–69, 2 refs. Cairo, 1958.

Ciba 570, a water-soluble preparation containing 20 per cent. phosphamidon, was tested against pests of cotton in Egypt in 1956. In the laboratory, it gave 98 per cent. mortality of first-instar larvae of *Prodenia litura* (F.) that fed for 48 hours on material that had been treated with about 3.5 pints of the preparation in 100 gal. spray per acre, as compared with 95 per cent. for 0.8 per cent. of an emulsion concentrate containing 60 per cent. toxaphene (octachlorocamphene) that was used as a standard. In a preliminary field test, the preparation proved more effective against *P. litura* in high-volume sprays than in low-volume sprays applied at about 12.5–15 gal. per acre, but the latter had perforce to be used in the subsequent work. In this, the mortality of newly hatched larvae 5–7 days after treatment varied from 20–42 per cent. when the spray afforded 0.16 gal. Ciba 570 per acre to 20–60 and 80–95 per cent. when it afforded 0.32 and 0.77 gal., respectively, as compared with 45–60 per cent. for the toxaphene spray. The material was not very persistent, and treatment had to be repeated every ten days for good control; when this was done, there was no advantage in increasing the rate above 0.16 gal. per acre; amounts above 0.77 gal. were phytotoxic to young cotton. It was also slow in action, the larvae not dying for 3–4 days. *Platyedra gossypiella* (Saund.) and *Earias insulana* (Boisd.) appeared later in the season, when the vegetation was more dense, and sprays affording 0.77 or 0.85 gal. Ciba 570 per acre reduced the percentages of bolls infested to 5–20, as compared with 35–66 on untreated plants. Populations of *Tetranychus telarius* (L.) and *Aphis gossypii* Glov. were low, but 38.5 and 15 per cent. of the leaves were attacked by these pests, respectively, on untreated plots, 37.5 and 3 per cent. on those treated with the toxaphene concentrate at 0.32 gal. per acre, and none on plots treated with phosphamidon at all rates. The numbers of predators before and (in brackets) after the fourth application of Ciba 570 at rates of 0.64, 0.77 and 0.85 gal. per acre and of toxaphene at 0.85 gal. per acre were 30 (30), 22 (17), 17 (14) and 9 (7) per 20 plants, respectively.

MEGAHED (M. M.) & EL-NAHAL (A. K. M.). **The spiny bollworm, *Earias insulana* Boisd., infesting maize ears in Egypt (Lepidoptera: Agrotidae-Acontiinae).**—*Bull. Soc. ent. Egypte* 42 pp. 71–74, 5 figs., 3 refs. Cairo, 1958.

In September 1955, unripe ears of sweet and field maize at Giza, Egypt, were found to be infested by 1–2 (or occasionally 4) larvae of *Earias insulana* (Boisd.). The nature of the damage caused is described. The infestation was most marked in September and early October, during the harvesting of cotton, of which the Noctuid is a well-known pest; no larvae were found in May–July 1956 in the ears of a crop sown in March. Pupation took place outside the ear.

SOLIMAN (S. A.) & SOLIMAN (A. A.). **Histopathological destruction caused to the cotton leafworm, *Prodenia litura* F., by some of the newer insecticides (Lepidoptera: Noctuidae).**—*Bull. Soc. ent. Egypte* 42 pp. 199–228, 51 figs., 35 refs. Cairo, 1958.

The histological changes brought about in the mid-gut, fat-body, muscles, Malpighian tubules, ventral nerve ganglion and haemolymph of larvae of

*Prodenia litura* (F.) by contact with DDT, toxaphene, parathion and Cotton-dust (containing 3 per cent.  $\gamma$  BHC, 10 per cent. DDT and 40 per cent. sulphur) are described from laboratory investigations in Egypt and comparison with normal tissues. General observations on fifth-instar larvae showed that they became inactive 1–1½ hours after the application of 0.1 per cent. parathion and discharged a liquid through the mouth, anus and body wall; those treated with 0.5 per cent. DDT became inactive in about two hours, showed convulsive movements after three hours, and became shrunken; those treated with 2 per cent. toxaphene began to liquefy within an hour; and those treated with Cotton-dust showed symptoms similar to those induced by DDT, but the shrinking was less marked though more rapid.

EL-NAHAL (A. K. M.). **Further experiments on the chemical control of *Thrips tabaci* Lind. and other insect pests infesting cotton seedlings.**—*Bull. Soc. ent. Egypte* 42 pp. 311–324, 1 graph, 10 refs. Cairo, 1958.

In continued field tests on the control of *Thrips tabaci* Lind. on seedling cotton in Egypt [cf. *R.A.E.*, A 47 315] in 1957, treatment of the seed with a dust containing 44 per cent. phorate (Thimet) at rates of 4.5–8.5 lb. per 100 lb. of seed, or with Disyston (50 per cent. O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate) at 6–10 lb. per 100 lb., protected the seedlings for about four weeks from the time of their emergence on 17th–21st March. Adults, and five days later nymphs, then appeared in small numbers, but no plants were injured, whereas 40 and 85 per cent. of those on untreated plots were injured by 30th March and all of them by 15th April. Peak populations of nymphs occurred in late March or early April and in early May. Both seed treatments gave protection over these periods, although phorate was only partly successful in controlling the second peak on one plot, on which there were 16–74 nymphs and 24–36 adults per 20 seedlings on 2nd May, as compared with 216 nymphs and 40 adults on seedlings from untreated seed. There were no appreciable differences in control between the different rates of application. Complete control of nymphs and adults for about 19 days was given by spraying the seedlings on 2nd April with emulsion concentrates containing 60 per cent. toxaphene, 20 per cent. Guthion, 30 per cent. DDT with 9 per cent.  $\gamma$  BHC (lindane), 20 per cent.  $\gamma$  BHC or 50 per cent. methyl-demeton (Metasystox), HOE 2671 (an emulsion concentrate containing 20 per cent. Thiodan, 70 per cent. xylene and 10 per cent. adhesive), and 50 per cent. dieldrin wettable powder at concentrations of 1, 0.2, 0.11, 0.1, 0.1 and 0.2 per cent. and 2 lb. per 100 gal., respectively. A second application on 25th April again gave immediate control, but only toxaphene, dieldrin and (to a less extent) methyl-demeton maintained it until 7th May.

HASSANEIN (M. H.). **Biological studies on the diamond-back moth, *Plutella maculipennis* Curtis (Lepidoptera: Plutellidae).**—*Bull. Soc. ent. Egypte* 42 pp. 325–337, 3 graphs, 12 refs. Cairo, 1958.

As *Plutella maculipennis* (Curt.) is an important pest of cruciferous vegetables in the Delta area of Egypt, its bionomics were studied in the laboratory in 1952–56. It was found that the adults emerge in the early evening and pair during the following afternoon. Eggs were laid 1.4–2.4 days later, usually in clusters of 2–6 along the midrib or a vein on the underside of the leaf, and the oviposition rate was highest during the first

three days. At 70 per cent. relative humidity, the average numbers of eggs laid per female were 0, 35, 224, 252, 134 and 38 at 10°C. [50°F.], 15°C. [59°F.], 20°C. [68°F.], 25°C. [77°F.], 30°C. [86°F.] and 35°C. [95°F.], respectively, and in field cages females laid 92–364 eggs each. Humidity had little effect on the duration of the egg stage, which varied from 14 days at 10°C. (with 75 per cent. mortality) to 1.5 days at 35°C. (with 95 per cent. mortality); only 1 per cent. mortality occurred at 20–30°C., when the incubation period was 5.5–2.5 days. The larval stage averaged 10.4 days in April–May and 29.7 days in October–November, when feeding was less voracious. Pupation occurred in a cocoon on the food-plant, and the pupal stage lasted 5 days at 30°C., 7 days at 25°C. and 14 days at 15°C. The average life-span of males and females was 6.3–15.4 and 5.7–10.3 days, respectively, with the shorter periods occurring in June and the longer in April. Females died about a day after completing oviposition. They comprised 46.5 per cent. of the adults caught in light-traps in 1952 and 38 per cent. in 1953. The catches in 1952 indicated that peak populations occurred in April and July–August, and no adults were taken in January–February or November–December, though in 1953 they occurred almost throughout the year, with moderately high numbers in February–March, a peak in April and a lesser peak in October–November. There were four generations in 1953. The Tineid overwinters in the pupal or adult stage. Of 312 full-fed larvae collected in 1954, 93 were parasitised by the Braconids, *Microplitis plutellae* Mues., *Apanteles* sp. and *Meteorus* sp., five died from disease caused by *Botrytis* sp. and nine died from unknown causes. Of 256 pupae, 27 were parasitised by *Brachymeria femorata* (Panz.).

**HAFEZ (Mostafa). Studies on the polyhedrosis-virus disease of the cotton leaf-worm, *Prodenia litura* F., in Egypt.**—*Bull. Soc. ent. Egypte* 42 pp. 357–370, 2 figs., 7 refs. Cairo, 1958.

The polyhedral virus disease of the larvae of *Prodenia litura* (F.) in Egypt [*cf.* R.A.E., A 46 27] was further investigated in 1954–55. First-, third- and fourth-instar larvae, kept in batches of 100 in laboratory cages at about 24°C. [75.2°F.], were fed on clover [*Trifolium alexandrinum*] that had been sprayed in the field with a suspension of 25 million polyhedra per cc. at a rate of 1 pint per 120 sq. yd. All died within 11 days, whereas there was only 41–58 per cent. mortality of larvae that fed on untreated clover; most of the first-instar larvae in the infected group died on the seventh day and most of the older larvae on the 3rd–6th days. Symptoms of the disease, of which one was loss of appetite, appeared 3–4 days before death. When batches of 50 larvae in the 1st–6th instars were similarly treated, there was little difference in susceptibility between the instars; all the larvae died within nine days, except for a few in the third instar, one of which survived for 30 days. When almost full-fed larvae were fed on virus-sprayed clover, there was 59–73 per cent. mortality among the resultant pupae, as compared with 33–36 per cent. among uninfected ones, and adults emerging from the survivors were malformed, did not oviposit and soon died. Exposure of the virus suspension on clover in the field reduced its virulence; although 100 per cent. of caged larvae died when they fed on the clover during the first three days after spraying, only 93.3, 83.3 and 60 per cent. did so after 4, 5 and 10 days, respectively. There were no significant differences between the effects of suspensions containing 25, 50 and 100 million polyhedra per ml. applied to clover at a rate equivalent to 1 pint per 120 sq. yd. in field tests late in 1954 and 1955, and the control afforded was insufficient to be of economic value.

HASSANIEN [HASSANEIN] (M. H.) & ZAKI (M. M.). **Studies on the susceptibility of different stages of the cotton leaf-worm, *Prodenia litura* F., to certain chlorinated compounds.**—*Bull. Soc. ent. Egypte* **42** pp. 411–419, 22 figs., 3 refs. Cairo, 1958.

In tests in Egypt, eggs and larvae of *Prodenia litura* (F.) were placed on filter paper in petri dishes, sprayed in a Potter tower with 2 cc. of different concentrations of DDT,  $\gamma$  BHC or toxaphene in acetone and observed for mortality after 24 hours. None of the insecticides inhibited embryonic development, but the newly hatched larvae died after moving about on the treated filter paper. The susceptibility of the larvae decreased with age, the median lethal concentrations increasing from 0.004 to 0.12 per cent. for DDT, 0.0003 to 0.012 per cent. for  $\gamma$  BHC and 0.002 to 0.15 per cent. for toxaphene as the larvae developed from the first to the sixth instar.

CALCAT (A.). **Diseases and pests of date palm in the Sahara and North Africa.**—*FAO Plant Prot. Bull.* **8** no. 1 pp. 5–10, 2 figs., 1 ref. Rome, 1959.

The pests here recorded attacking date palms in French North Africa comprise *Parlatoria blanchardii* (Targ.), which has spread from Algeria into Morocco, infests the leaves and even the fruits, and is attacked by species of *Cybocephalus*, *Pharoscyrnus*, *Scymnus* and *Chrysopa* [cf. *R.A.E.*, A **46** 296, etc.], *Oligonychus pratensis* (Banks) (*Paratetranychus simplex* (Banks)), which infests the fruit clusters and occurs throughout North Africa, various larvae that attack ripe dates, *Apanteles monacha* F. and other occasional borers in weakened palms, and *Schistocerca gregaria* (Forsk.).

**Outbreaks and new records.**—*FAO Plant Prot. Bull.* **8** no. 1 pp. 11–12, 1 fig., 2 refs. Rome, 1959.

Insects reported in the United States for the first time in January–September 1959 (p. 12) included *Haplothrips clarisetis* Priesn., which occurred in California in March and later killed lettuces in New Mexico, *Cydia* (*Laspeyresia*) *fletcherana* (Kearfott), which infested the bark of Douglas fir [*Pseudotsuga menziesii*] in Montana in the autumn of 1958, *Apanteles galleriae* Wlkn., which was found parasitising *Galleria mellonella* (L.) in North Carolina, *Aglossa pinguinalis* (L.), a potential pest of grains, which occurred in Massachusetts, and *Sinoryllon conigerum* Gerst., which bored in sapodilla [*Achras zapota*] 8–10 ft. tall at Miami in August and apparently killed the tree.

ALLEN (W. W.). **The biology of *Apanteles medicaginis* Muesebeck (Hymenoptera: Braconidae).**—*Hilgardia* **27** no. 18 pp. 515–541, 5 figs., 74 refs. Berkeley, Cal., 1958.

ALLEN (W. W.) & SMITH (R. F.). **Some factors influencing the efficiency of *Apanteles medicaginis* Muesebeck (Hymenoptera: Braconidae) as a parasite of the alfalfa caterpillar, *Colias philodice eurytheme* Boisduval.**—*Op. cit.* **28** no. 1 pp. 1–42, 6 figs., 50 refs. 1958.

In the first of these papers, the author summarises knowledge on parasitism by *Apanteles* spp. of the species of *Colias* that develop on

leguminous plants and discusses the North American distribution and diagnostic characters of *A. medicaginis* Mues. and *A. flaviconchae* Ril., which parasitise species of this genus in the west and east of the United States, respectively [cf. *R.A.E.*, A 37 333], and the distribution of *A. medicaginis* in California. *A. medicaginis* is a solitary parasite of *C. eurythème* Boisd., of which the preferred food-plant is lucerne, and *A. flaviconchae* is a gregarious parasite of *C. eurythème* and *C. philodice* Godt., which prefers red clover (*Trifolium pratense*); the classification of forms of this complex of *Colias* is briefly reviewed [cf. 33 339].

The two species of *Apanteles* are very much alike, but can be distinguished by differences in the female genitalia. It is unlikely that they are now geographically isolated, but observations indicate that they developed their differences in biology when they were so separated and that *C. philodice* and *C. eurythème* developed their differences in colour and food preferences, a tendency to prefer mating with their own kind and other biological characteristics at the same time. *C. eurythème* is an important pest of lucerne in California, and *A. medicaginis* is its principal parasite there. With the increase in the areas under lucerne and the consequent spread of *C. eurythème* to the east of the United States, *A. medicaginis* extended its range in that direction, and it has been found as far east as Kansas parasitising *C. eurythème*. *A. medicaginis* and *A. flaviconchae* did not mate in the laboratory, because of the difference in size, though males of each were attracted to females of the other. It seems likely that they are reproductively isolated, and *A. medicaginis* would probably be intrinsically superior if they occurred in the same area, since its internecine action and earlier emergence from the host would probably preclude development of *A. flaviconchae* in a host parasitised by both species. The lack of success in attempts to establish *A. flaviconchae* against *C. eurythème* in California, however, was probably due to some other factor, since parasitism by *A. medicaginis* in the fields concerned was not high.

Methods by which *A. medicaginis* was reared on *C. eurythème* in the laboratory in California are described, together with all stages of the parasite. It was found that eggs are laid singly in larvae in the first, second or third instar, and that the parasite larva emerges from the host when the latter is in the third instar if parasitism occurs early in the first instar and when it is in the fourth if parasitism occurs later. As most larvae emerged from third-instar hosts in the field, small larvae appear to be preferred for oviposition. *A. medicaginis* has been reared only from *C. eurythème* in the field, and did not oviposit in the larvae of other Lepidoptera in the laboratory. At 80°F., the eggs hatched in 24–30 hours, and the total time spent in the host was 7.5–10 days. After leaving its host, which died soon after, the larva spun a cocoon, in which it pupated after about 24 hours and transformed to the adult after about another three days. Periodic sweeps in lucerne fields in the San Joaquin Valley indicated that *A. medicaginis* overwinters in the larval stage in overwintering *Colias* larvae, a high proportion of which were parasitised. There was no true diapause. No *Apanteles* cocoons were found in winter, but adults were collected throughout the year, though they were rare in winter. The number of generations a year depends on the climate and availability of hosts. Populations are relatively low in spring, because of low host density, but often become high as the *Colias* population increases in summer and autumn.

The following is based on the authors' summary of the second paper. Studies on the rates of development of *C. eurythème* at various temperatures showed that it becomes of economic importance only at high ones. At low temperatures, the period of development exceeds the time normally elapsing

between successive cuttings of lucerne, and populations do not develop to injurious levels. It is only in areas with high temperatures, therefore, that *A. medicaginis* becomes an important control factor. The parasite requires a much shorter time for development and should be able to respond rapidly to changes in host density, but this ability is limited by the changes in habitat produced by cutting the lucerne. Cutting causes *Colias* populations to be relatively even-brooded in any particular field and also makes periodic movement of host and parasite populations necessary. Because *Colias* larvae in any particular field are more or less in the same stage of development, and because lucerne is cut about every 30–35 days, it is very difficult for *A. medicaginis* to complete two generations in a field between cuttings, so that emerging females must either seek out another population of *Colias* that is in a suitable stage for parasitism or wait for the emergence and reproduction of the host in the same field. This difference in time of emergence, coupled with the difference in flight characteristics and host habitat selection, may sometimes result in concentrations of hosts in one field and parasites in another, and when the numbers of *Apanteles* females are small and those of *Colias* larvae very large, the limited survival period and associated low reproductive capacity of *A. medicaginis* are important factors limiting its effectiveness. Areas that contain many sources of food for the adult parasites, thus favouring longer life, generally have a higher degree of parasitism.

*A. medicaginis* shows little discrimination between parasitised and unparasitised hosts under crowded conditions in the laboratory, but dissection of numerous field-collected *Colias* larvae indicated that superparasitism is very low and not important in limiting the efficiency of *A. medicaginis*. The parasite has a sex ratio of 1:1, and the environmental conditions normally encountered have little influence on this. Hyperparasitism seems of little importance, because of the lack of opportunities for parasites to attack *A. medicaginis* and the adverse effect that cutting the lucerne has on their development.

FLANDERS (S. E.), GRESSITT (J. L.) & FISHER (T. W.). *Casca chinensis*, an internal parasite of California red scale.—*Hilgardia* 28 no. 3 pp. 65–91, 9 figs., 25 refs. Berkeley, Cal., 1958.

The following is based largely on the authors' summary. *Casca chinensis* How. [cf. *R.A.E.*, A 45 377] is an apparently specific endoparasite of *Aonidiella aurantii* (Mask.) on *Citrus* in southern China, and its use to control the scale in California has been envisaged ever since its discovery in 1906; the various attempts that have been made to introduce and propagate it and the biological tests involved are reviewed. Outdoor propagation was successful in China, but reproduction in the laboratory and the importation of the parasite into California and its colonisation there have failed, because the particular conditions necessary for the production of the male remain unknown. Fertilised eggs give rise to females, but unfertilised eggs fail to develop in *A. aurantii*. Sex differentiation in host-parasite relations is characteristic of certain Hymenoptera, and its nature seems unusually obscure in *C. chinensis*. The results of experiments, which are described in detail, suggest that the male is not a hyperparasite and that its development is not affected by the age of the host or by changes in it induced when a mated parasite oviposits in it. Factors that may affect the production of males are discussed and further methods of research suggested.

STERN (V. M.), VAN DEN BOSCH (R.) & BORN (D.). **New control for alfalfa aphid.**—*Calif. Agric.* **12** no. 1 pp. 4-5, 13. Berkeley, Cal., 1958.

In view of the failure of insecticides to control *Therioaphis maculata* (Buckt.) on lucerne in southern California in 1956, presumably owing to the destruction of its natural enemies [*cf. R.A.E.*, A **47** 331], several compounds were tested in field sprays in 1957 in a search for a selective material that would control the aphid but not affect the parasites or predators of this or other pests. In sprays applied at 12-14 U.S. gal. per acre with ground equipment on 5th February, 0.9 or 1.4 oz. demeton or 3 oz. parathion per acre gave 99 per cent. reduction of the aphid population in 1-7 days, as compared with no treatment; demeton also gave satisfactory control when applied at 2 oz. per acre by aeroplane. When similar sprays were applied on 10th April, counts made 1-9 days later showed that 0.5 and 0.9 oz. demeton per acre were generally less toxic to predacious species of Coccinellids, *Nabis*, *Orius* and *Chrysopa* than 9.1 oz. malathion, 4 oz. parathion or 0.7 oz. Phosdrin: these three compounds reduced the Coccinellids by 88 per cent. in one day, kept the numbers low throughout the test and were very toxic, in this and other tests, to the other predators, which, though less important against the aphid, give good control of other pests. Trithion, at 7.2 oz. per acre, showed a delayed action against the Coccinellids and was generally more toxic than demeton and less so than the other materials to all the beneficial insects. When applied in sprays on 10th June, 3 oz. parathion and 9.7 oz. malathion per acre were very toxic to adults of the Braconid parasite, *Praon palitans* Mues. [*cf. loc. cit.*]; they caused 97 per cent. mortality in five hours, as compared with 90 per cent. for 1 oz. Phosdrin or 5 oz. Trithion and 80 and 66 per cent. for 1 and 2 oz. demeton per acre, and kept the numbers low on the day after application, apparently by killing the adults as they emerged or migrated into treated areas. There was little difference in numbers after three days, however, and none of the sprays affected the parasites in the cocoon stage.

In sprays applied by aeroplane on 13th August, 4 oz. parathion per acre killed 95-100 per cent. of the predators in one day and kept the numbers low throughout the test period of seven days; 1.5 oz. Phosdrin was rather less harmful, and 2 oz. demeton reduced Coccinellids and *Orius* by 24-28 per cent., Chrysopids by 58 per cent. and *Nabis* by only 4 per cent. There was an average of less than one aphid per lucerne stem in treated plots after one day, but heavy immigration by alates resulted in averages of 11 and 8 per stem in the parathion and Phosdrin plots after seven days and of 14 and 8 after ten days, when the average for demeton was still only 1.5.

It is concluded that as fewer applications of demeton than of other materials would be needed, its use should reduce costs and the tendency of the aphid to develop resistance. There would also be less likelihood of outbreaks of other insects such as sometimes follow the use of more widely toxic insecticides.

MADSEN (H. F.). **Chemicals on European red mite.**—*Calif. Agric.* **12** no. 2 pp. 8, 15. Berkeley, Cal., 1958.

In field-plot tests in five counties of northern and central California in 1957, a single spray application of Kelthane or Tedion gave good control of the European red mite [*Paronychus ulmi* (Koch)] and the two-spotted mite [*Tetranychus telarius* (L.)] on pear, usually for nine weeks or longer,

and Trithion was equally effective in all but one county, in which resistance to phosphates had been recorded; all gave longer-lasting control than did Sulphenone [p-chlorophenyl phenyl sulphone], which failed 3-4 weeks sooner.

In tests against the codling moth [*Cydia pomonella* (L.)] on apple, Trithion and ethion (Nialate) controlled *P. ulmi* [cf. *R.A.E.*, A 47 419-420], but sprays of DDT, alone or with parathion, or of ryania or Sevin showed no acaricidal effect. The addition of 6.8 lb. 25 per cent. Tedion to DDT and of 11.4 U.S. pints 18 per cent. Kelthane to Sevin sprays on 18th July reduced *P. ulmi* for the rest of the season, whereas, in an orchard with a history of resistance to chlorfenson (ovex), 10.2 lb. 50 per cent. chlorfenson, added to DDT and parathion, and 3.3 lb. 50 per cent. fenson, added to ryania, had no effect on mites.

In tests against the woolly apple aphid [*Eriosoma lanigerum* (Hsm.)], in an apple orchard in which mites had proved resistant to malathion and parathion in previous seasons, two applications of sprays of 1 U.S. pint 48 per cent. Thimet or four of 1 lb. 25 per cent. ethion or 1.5 U.S. pints 18 per cent. Guthion per 100 U.S. gal. gave commercial control of mites, but two of 1 lb. 25 per cent. diazinon or four of 2 lb. 25 per cent. Thiodan per 100 U.S. gal. were ineffective.

LANGE (W. H.) & BACON (O. G.). **Crown mite damage on spinach.**—*Calif. Agric.* 12 no. 2 pp. 9, 16, 2 figs. Berkeley, Cal., 1958.

Since 1949, a species of *Tyrophagus* referred to as *T. dimidiatus* (Herm.) [cf. *R.A.E.*, A 31 69, 157; 34 161] has caused periodic damage to spinach sown in autumn or spring in many parts of California, but mainly in the coastal regions. The mites feed on new growth in the crown and oviposit in the folds of the young leaves. All stages occur together, and they are often accompanied by other mites of less importance and by the seed corn maggot [*Hylemyia cilicrura* (Rond.)], which may cause additional crown damage. Infestation by *T. dimidiatus* usually occurs in localised parts of a field; it may result from excessive organic fertiliser or plant debris in the soil and damage is sometimes reduced by dry warm weather and rapid growing conditions. Control may be necessary when there is an average of five mites or more per centre leaf, and is most effective when the plants are small. Applications of 40-50 lb. per acre of a dust containing 2 per cent. parathion, with or without 7.5 per cent chlorfenson (ovex), gave 87-92 per cent. control after 2-9 days and was more effective than treatment with a parathion emulsion spray, a nicotine spray or dust or a dust of Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], though all these gave some control.

RETAN (A. H.), POST (G. R.), DAVIS (C. S.) & MICHELbacher (A. E.). **Filbertworm control trials.**—*Calif. Agric.* 12 no. 4 pp. 10-11, 1 graph. Berkeley, Cal., 1958.

The filbertworm [*Cydia latiferreana* (Wlsm.)] was injurious to walnuts in northern California each year from 1954 to 1957 [cf. *R.A.E.*, A 44 173]; it occurs throughout the walnut-producing areas there, but is apparently most important in the Sacramento Valley. Slight infestations occurred in orchards outside the main area of attack in 1957 and complicated the problems already caused by the codling moth [*C. pomonella* (L.)] and the navel-orange worm [*Paramyelois transitella* (Wlk.)], of which *Myelois*

*venipars* Dyar, *M. duplipunctella* Rag. and *M. notatalis* (Wlk.) are synonyms].

Guthion and Sevin were applied for the control of *C. latiferreana* in two orchards on 20th August 1957, just before the husks began to split. In one, in which two sprays had already been applied against *C. pomonella*, 10 lb. 15 per cent. wettable Guthion and 12 lb. 50 per cent. wettable Sevin in 250 U.S. gal. water per acre, applied with an air-carrier sprayer, reduced the percentage of infested nuts in the harvested crop of one variety from 14.4 for no treatment to less than three, whereas an application of Guthion on 4th September was ineffective. In the other, applications of 2.5 lb. 15 per cent. wettable Guthion or 3 lb. 50 per cent. wettable Sevin per 100 U.S. gal. water at 25 and 17 U.S. gal. per tree, respectively, with a conventional sprayer were promising, though less effective.

LANGE jr. (W. H.), BAILEY (S. F.) & UNDERHILL (J. P.). **Cutworms on white asparagus.**—*Calif. Agric.* **12** no. 4 pp. 13–14, 2 figs. Berkeley, Cal., 1958.

*Euxoa messoria* (Harris), which is widely distributed in the United States, causes economic damage to asparagus in the delta area of central California every year. The larvae feed at night on the tender tips and sometimes on the leaves, and damage 15–40 per cent. of the shoots. The eggs are apparently laid in cultivated fields, and some hatch in the same year, whereas others probably overwinter in the soil. Larvae overwinter under debris or rocks, damage asparagus between April and mid-June and pupate in July; the adults emerge between July and the autumn.

The results of tests with baits for control of the larvae showed that endrin was more effective than aldrin, dieldrin, heptachlor, calcium arsenate or sodium fluosilicate and that a concentration of 0.5–1 per cent. was necessary for adequate control; it acts by contact as well as on ingestion. A bait of equal quantities of bran and apple pomace containing 1 per cent. endrin, 2 per cent. heavy-grade spray oil and a small quantity of amyl acetate gave good results in experiments, and commercial treatment with one containing 0.75 per cent. endrin, applied from aircraft at 20–40 lb. per acre on 10th May, gave complete kill in 4–5 days. Asparagus culls dipped in 2 per cent. endrin suspension also gave good control when scattered on the beds at the rate of 300 lb. per acre, but neither baits nor sprays of this or other chlorinated hydrocarbons were effective when it was too cold for larval activity or when the soil was so warm that the larvae remained at too great a depth.

Endrin baits were also effective against species of *Blapstinus* on asparagus and against cutworms and *Blapstinus* attacking other vegetable and field crops. They should not be used on leafy vegetables or allowed to contaminate the plant parts. Endrin is registered in the United States for use on white asparagus, when no shoots are present, but not on green asparagus, because of lack of information on the residues.

WEDDING (R. T.), RIEHL (L. A.) & JEPSON (L. R.). **Red mite on Citrus.**—*Calif. Agric.* **12** no. 8 pp. 9–10, 12, 3 figs. Berkeley, Cal., 1958.

Infestation of *Citrus* by the red mite [*Panonychus citri* (McG.)] in California causes leaf stippling or scarring, excessive leaf-drop, dieback of twigs and reductions in the yield and in the quality of the juice, and experiments were undertaken to measure the precise effects of its feeding.

Mites were allowed to feed on lemon plants in the greenhouse for two weeks, after which they were removed, and comparisons of photosynthesis and respiration in injured leaves and those from uninfested plants were begun some days later and continued for over six months. The quantity of oxygen produced per sq. cm. of leaf surface per hour was significantly less from damaged than from normal leaves until 26 weeks after the beginning of infestation, indicating that damage reduces the rate of production of carbohydrates for several months. This was confirmed by the measurement of photosynthesis in damaged and undamaged leaves of lemon and lime. No significant difference in respiration was found between injured and uninjured leaves under the conditions of the experiment.

Some of the observed effects of heavy infestation, such as leaf-drop, might be attributed to severe alterations in transpiration, and a greenhouse test is described in which this was measured on potted lemon plants for six months after they had been damaged by mites. The pots were enclosed in polyethylene bags tied round the stems of the plants, so that water was lost only through the leaves, and the individual plants were weighed in the morning and about six hours later. Leaf areas were measured and used to calculate the rate of transpiration. Comparison with the results for uninfested plants showed that mite feeding caused an initial inhibition of water loss, which was significantly reduced for about five months. Somewhat similar tests showed no effect on the transpiration of tangerine, but significant depression of that of grapefruit. In more accurate tests on navel-orange trees, begun when the plants were first infested, mite feeding caused a considerable initial stimulation of transpiration in the leaves, which reached a maximum on the second day but then rapidly declined, so that there was an appreciable inhibition of transpiration at the end of a week.

No differences in the quality of the fruit juice or the yield were observed on infested and uninfested lemon trees over a period of more than a year, and a heavy infestation of navel-orange in the autumn of 1957 did not reduce the number of fruits at harvest, but lowered their grade.

KERR (S. H.) & ROBINSON (F. A.). **Chinch bug control tests, 1956-57.**—*Florida Ent.* **41** no. 3 pp. 97-101, 3 refs. Gainesville, Fla., 1958.

In further plot tests on the control of *Blissus insularis* Barber in grass lawns [cf. *R.A.E.*, A **45** 100] carried out at six localities in Florida in 1956-57, in which 15 compounds were applied in water from a watering can at a rate of 5 U.S. gal. per 100 sq. ft., emulsion concentrates of diazinon and V-C 13 [O.O-diethyl O-2,4-dichlorophenyl phosphorothioate] (a nematicide), at 4 and 16 lb. actual ingredient per acre, respectively, proved as effective as DDT and parathion. Two applications of diazinon 1½-2 weeks apart were required to achieve results equal to those given by V-C 13, and it is recommended that the dosage of each should be doubled in the southernmost parts of Florida, where the climate and conditions of turf development are extreme and DDT gave poor results.

GENUNG (W. G.) & HAYSLIP (N. C.). **Observations on biology and ecology of *Tortrix irana* Fernald (Lepidoptera: Tortricidae), as a pest of celery in the Florida Everglades, and notes on its control.**—*Florida Ent.* **41** no. 3 pp. 133-141, 4 graphs, 7 refs. Gainesville, Fla., 1958.

*Argyrotaenia (Tortrix) irana* (Fern.) has been a sporadic pest of celery in the Everglades region of Florida since 1933 [cf. *R.A.E.*, A **22** 576], and

an infestation in the spring of 1948 led to a study of its bionomics. All stages of the Tortricid are described. It was found that irregular masses of 6-60 eggs (usually not more than 25) are laid on either surface of the leaves and sometimes on the petioles. Five females were observed to lay an average total of 105 eggs each in 2-6 clusters, and the eggs hatched in 5-12 days. The larvae web the leaves together and later bore in the petioles of succulent plants, causing the main damage to the crop; losses of up to 50 per cent. have been reported. When full-fed, the larvae return to the leaves for pupation, and the larval and pupal stages lasted 16-20 and 7 days, respectively, in May. Development from egg to adult lasted 31-44 days in spring and summer, but the number of generations a year was not determined. The late summer, autumn and winter generations occur at periods of low population, and further generations may develop in mild winters. Adults have been taken in most parts of peninsular Florida, and immature stages have been found on 18 species of plants in 11 families. Larvae also completed their development under experimental conditions on plants in other families. The only parasites reared were a Bethyloid, *Goniozus platynotae* Ashm., from the larvae, and *Trichogramma* sp., from the eggs, but larval mortality in the insectary and in the field in late summer was so rapid as to suggest the occurrence of a disease. Light-trap catches in 1951-55 showed that the adult population reached its peak in late May or June, when the harvesting of celery was almost complete, and that no moths were present in September-January. Damage to celery is therefore most likely to occur late in the season.

No tests on control were carried out because of the low populations encountered, but adults were only one-third as numerous in a part of a field treated in April with parathion as in the untreated part, and a 5 per cent. DDT dust proved satisfactory in 1948. A dust of 5 per cent. DDT with 1 per cent. parathion is suggested, or an emulsion spray of 1 quart 25 per cent. DDT with 1 pint 25 per cent. parathion per 100 gal. at a rate of 200 U.S. gal. per acre.

**PATHAK (M. D.) & PAINTER (R. H.). Effect of the feeding of the four biotypes of corn leaf aphid, *Rhopalosiphum maidis* (Fitch) on susceptible White Martin sorghum and Spartan barley plants.—*J. Kans. ent. Soc.* 31 no. 2 pp. 93-100, 2 figs., 7 refs. Manhattan, Kans., 1958.**

The four biotypes of *Aphis* (*Rhopalosiphum*) *maidis* Fitch isolated in Kansas [*R.A.E.*, A 47 376] were compared for the degree of injury that they caused to a susceptible variety of sorghum and one of barley in greenhouse tests carried out in 1956-57. The differences, as measured in dry weights of tops and of roots of the plants, were not related to differences in fecundity, and it has been shown [*loc. cit.*] that fecundity is not related to the amount of plant material taken. It was therefore apparent that the plants varied in their tolerance of the different biotypes. On the sorghum, stunting was caused by biotypes KS-1, KS-3, KS-2 and KS-4, in order of descending severity, and the sequence on the barley was KS-1, KS-4, KS-2 and KS-3; the degrees of injury to sorghum and barley were comparable. The height of the plants was not a complete indication of the damage sustained, for the dry weights of barley tops were decreased more than those of sorghum tops in proportion to their height. The dry weights of tops of sorghum and (in brackets) of barley plants, taken one month after infestation at the two-leaf stage by 30 apterous adults of biotypes KS-1, KS-2, KS-3 and KS-4 and expressed as percentages of those for uninfested plants, averaged 26.74 (14.15), 32.14 (22.74), 28.24 (26.28) and 46.07 (15.51),

respectively. The corresponding percentages for the roots averaged 10.18 (9.67), 16.35 (19.87), 10.36 (29.38) and 18.21 (11.83), so that in general barley was more affected than sorghum and the roots more than the tops.

STEINHAUS (E. A.) & SMITH (R. F.). Ed. **Annual review of entomology.** Volume 5.—9 × 6 in., viii + 451 pp., illus., many refs. Palo Alto, Cal., Annual Reviews, Inc., 1960.

The reviews in this fifth volume of a series [*cf. R.A.E.*, A 45 70; 47 140, etc.] comprise: **Insect flight muscles and their basic physiology**, by E. G. BOETTIGER (pp. 1–16, 2 graphs, 69 refs.); **Insect micromorphology**, by G. A. EDWARDS (pp. 17–34, 93 refs.), who discusses the fine structure of insect organs and tissues; **Neurosecretion in insects**, by W. G. VAN DER KLOOT (pp. 35–52, 1 fig., 157 refs.); **The physiology of excretion in the insect**, by R. CRAIG (pp. 53–68, 75 refs.); **Cytogenetics of insects**, by S. G. SMITH (pp. 69–84, 104 refs.); **Chromosomal variation and adaptation in insects**, by A. BRITO DA CUNHA (pp. 85–110, 145 refs.); **The phylogeny of Coleoptera**, by R. A. CROWSON (pp. 111–134, 76 refs.); **Northern biting flies**, by B. HOCKING (pp. 135–152, 290 refs.); **Evolution and biology of the termites**, by F. M. WEESNER (pp. 153–170, 102 refs.); **Biology of fruit flies**, by L. D. CHRISTENSON & R. H. FOOTE (pp. 171–192, 62 refs.), which includes a table showing the distribution, host-fruits or food-plants, the duration of the various stages and the fecundity of 14 representative species of Tryptetids of economic importance in various parts of the world, comprising *Epochra canadensis* Lw., *Eulcia (Acidia) heraclei* (L.), *Platyparea poeciloptera* (Schr.), *Myiopardalis pardalina* (Big.), *Ceratitis capitata* (Wied.), two species of *Anastrepha*, three of *Rhagoletis* and four of *Dacus*; **Host selection in phytophagous insects**, by A. J. THORSTEINSON (pp. 193–218, 76 refs.), who discusses factors affecting the selection of their food-plants by insects and presents a revised catenary theory based on the views of V. G. Dethier, with links in the chain of stimuli occurring in parallel as well as in sequence; **Some recent contributions to the study of the distribution and abundance of insects**, by H. G. ANDREWARTHA (pp. 219–242, 54 refs.), who reviews investigations that show how the abundance of populations of an insect or other arthropod may be determined by weather, food, other organisms and the requirement of a place in which to live, with some consideration of the occurrence of races; **Sampling insect populations**, by R. F. MORRIS (pp. 243–264, 102 refs.), who discusses the objects of population sampling and methods of carrying it out; **The use of honey bees in the production of crops**, by F. E. TODD & S. E. MCGREGOR (pp. 265–278, 71 refs.), which includes a table in which insecticides and fungicides are classified according to their toxicity to honey bees; **The biological background of locust control**, by D. L. GUNN (pp. 279–300, 145 refs.), who reviews the occurrence of phases in locusts, the concept of outbreak areas, migration by swarms, the population dynamics of locusts, the forecasting of outbreaks, and the various methods of control available; **Mechanisms of resistance against insecticides**, by A. W. A. BROWN (pp. 301–326, 221 refs.), in which the principal insecticides considered are DDT, dieldrin, BHC, various organophosphorus compounds, pyrethrins, hydrogen cyanide and arsenicals; **Some aspects of the application of insecticides**, by R. J. COURSHÉE (pp. 327–352, 5 figs., 42 refs.), who discusses methods of applying insecticides in sprays and dusts for the control of insect pests of plants and factors that influence their effectiveness; **Citrus insects and mites**, by L. R. JEPPESON & G. E. CARMAN (pp. 353–378, 236 refs.), who consider the more significant contributions made during the past decade on the insects

and mites that infest *Citrus* in various countries, notably those on their bionomics, ecology, and control; **Pesticides in relation to public health**, by W. J. HAYES jr. (pp. 379-404, 5 graphs, 107 refs.), who reviews the benefits to health resulting directly from the use of chemicals for the control of arthropod vectors of diseases of man and indirectly from their use against insect pests of plants through increased production of foodstuffs and other materials, the great increase in quantities of insecticides used, the hazards to health involved in their production and application, methods of minimising such hazards, and the diagnosis and treatment of accidental poisoning; and **Biological relationships between lice (*Anoplura*) and microbial agents**, by F. WEYER (pp. 405-420, 96 refs.).

In addition to the usual index to the authors whose work is reviewed and one to the subjects discussed, cumulative indexes to the reviews, classified under broad headings, and to the contributing authors for all the five volumes so far published are included.

GYSIN (H.) & MARGOT (A.). **Chemistry and toxicological properties of O,O-diethyl-O-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate (diazinon)**.—*J. agric. Fd Chem.* 6 no. 12 pp. 900-903, 1 graph, 12 refs. Easton, Pa., 1958.

The following is substantially the authors' summary. Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate) is prepared by condensation of 2-isopropyl-4-methyl-6-hydroxypyrimidine with O,O-diethyl phosphorochlorothioate. The presence in the latter of small amounts of O-ethyl phosphorodichloridothioate and triethyl phosphorothioate results in technical diazinon, which contains as impurities triethyl phosphorothioate and O-ethyl O,O-di(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate. Diazinon is obtained in a pure state by distillation or through formation of a mineral acid salt. Pure diazinon is not a potent cholinesterase inhibitor, but on distillation or long standing increased anticholinesterase inhibitory activity is found. Various possible isomerisation and decomposition products were prepared, but the compound responsible for the increased activity was not found.

YAFFE (J.). **Stabilization of Aramite by glycols**.—*J. agric. Fd Chem.* 6 no. 12 pp. 903-905, 3 graphs, 3 refs. Easton, Pa., 1958.

The following is virtually the author's summary. Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) is unstable and decomposes when formulated as a commercial pesticide in certain fillers. The technical material contains 0.5 per cent. propylene oxide, which serves as a stabiliser, but it was found to be ineffective in wettable-powder or dust formulations in laboratory and field studies. The rate of decomposition was influenced by temperature, pH, moisture, and the catalytic activity of various diluents. The compound was stabilised in wettable-powder and dust formulations by the use of various glycols, of which dipropylene glycol was the most effective.

FULLMER (O. H.) & CASSIL (C. C.). **Colorimetric microdetermination of the acaricide 2,4,5,4'-tetrachlorodiphenyl sulfone**.—*J. agric. Fd Chem.* 6 no. 12 pp. 906-908, 2 graphs, 5 refs. Easton, Pa., 1958.

The following is virtually the authors' summary. A microanalytical method for the determination of the new acaricide Tediion is presented.

Nitrated Tedion produces a red colour with an absorption maximum at 520 m $\mu$  when treated with alkali in the presence of pyridine. The method responds in the range of 5 to 50  $\mu$ g. Tedion.

CASSIL (C. C.) & FULLMER (O. H.). **Persistence of Tedion residues on fruits.**—*J. agric. Fd Chem.* **6** no. 12 pp. 908–910, 3 refs. Easton, Pa., 1958.

In a study of the persistence of Tedion residues on fruits in California, apple, pear, peach, lemon and orange trees were sprayed with 1 or 3 lb. 25 per cent. wettable powder per 100 U.S. gal. 32 days before harvest. The residues from the weaker spray ranged from 1.2 to 3.3 parts per million on the fruits immediately after treatment, but fell to less than 1 p.p.m. on all except lemon 32 days later, and those from the stronger spray ranged from 2.5 to 7 p.p.m. immediately after treatment and fell to 2 p.p.m. or less on all except lemon after 32 days. The lemons, unlike the other fruits, showed no increase in weight during the period. When mature navel oranges, which had also reached maximum size, were similarly sprayed, there were no significant decreases in residues over 100 days, and field observations on miscellaneous fruits confirmed the persistence of the material. It is concluded that Tedion is resistant to weathering, most of the apparent decline in residues being due to fruit growth.

ZWEIG (G.) & ARCHER (T. E.). **Residue determination of Sevin (1-naphthyl N-Methylcarbamate) in wine by cholinesterase inhibition and paper chromatography.**—*J. agric. Fd Chem.* **6** no. 12 pp. 910–913, 1 fig., 3 graphs, 7 refs. Easton, Pa., 1958.

Sevin has been found effective in sprays against the grape leaf folder [*Desmia funeralis* (Hb.)] in California, and two methods were developed for the measurement of the possible residues of this insecticide in the wine made from sprayed grapes. One, based on *in vitro* inhibition of cholinesterase, measures the actual Sevin present, and the other, a paper chromatographic method, measures Sevin and its metabolic breakdown product, 1-naphthol. Details of the procedures are given.

CRAM (W. T.) & TONKS (N. V.). **Note on occurrence in British Columbia of the omnivorous leaf tier, *Cnephasia longana* (Haw.) (Lepidoptera: Tortricidae), as a pest of strawberry.**—*Canad. Ent.* **91** no. 3 pp. 155–156, 5 refs. Ottawa, 1959.

The introduced Tortricid, *Cnephasia longana* (Haw.), is an important pest of strawberry, flax, vetch [*Vicia*] and other plants in the western United States [*cf. R.A.E.*, **A** **33** 342; **38** 336, 337; **42** 160], but had not been reported from Canada until June 1957, when larvae were found in British Columbia infesting ripening strawberries in Vancouver Island and the picked fruits at a processing plant in the lower Fraser Valley. In 1958, infestations occurred in widely separated plantings at the same place in Vancouver Island, where the larvae were found on strawberry fruits and foliage and also on thistle, vetch and clover in neighbouring pasture areas, and throughout most of the major strawberry-growing areas in the lower Fraser Valley, where the larvae were collected from strawberries and, in one place, from Canada thistle [*Cirsium arvense*]. Strawberry plantings that had been sprayed in spring with malathion or diazinon against aphids were rarely attacked. A species of *Atrometus* was reared from parasitised larvae collected in Vancouver Island. Notes on the bionomics and control of *C. longana* are given from the literature.

D'AGUILAR (J.) & MISSONNIER (J.). **Différences biologiques et morphologiques entre *Pegomyia betae* Curt. et *P. hyoscyami* Panz. (Dipt. Muscidae).**—*Bull. Soc. ent. Fr.* **62** no. 5-6 pp. 124-131, 2 figs., 18 refs. Paris, 1957.

CHILLCOTT (J. G.). **The *Pegomyia hyoscyami* (spinach leaf miner) complex in North America (Diptera: Muscidae).**—*Canad. Ent.* **91** no. 3 pp. 167-170, 6 figs., 6 refs. Ottawa, 1959.

Considerable confusion has existed regarding the status of forms of the complex of *Pegomyia hyoscyami* (Panz.) that infest various plants. The authors of the first of these papers summarise published opinions on those that attack Solanaceae and Chenopodiaceae [*cf.* R.A.E., **A** 2 616; **4** 323; **26** 314; **41** 432] and present evidence, based on observations in northern France, indicating that the light and dark forms that have hitherto been referred to as *P. hyoscyami* and *P. hyoscyami* var. *betae* (Curt.), respectively, are distinct species. The two were found together on sugar-beet at an experiment station at Versailles over a period of several years, and, on examination, morphological differences, which are described, were observed in both the eggs and the adults, including differences in the genitalia, particularly of the males. Developmental differences were also found, since larvae of *P. betae* always pupated in the soil, whereas those of *P. hyoscyami* pupated in the leaves until the beginning of August, after which date progressively more and more pupated in the soil; only those that entered the soil underwent diapause. *P. betae* is widespread on beet in northern France, but *P. hyoscyami* was rarely found outside the beet fields of the experiment station. When caged with single plants, females of *P. betae* laid far more eggs on sugar-beet than on *Chenopodium*, *Solanum nigrum* (black nightshade) or *Datura* [*stramonium*], whereas those of *P. hyoscyami* laid about equal numbers on sugar-beet, *Chenopodium* and *Datura*, but very few on *S. nigrum*, perhaps because of its hairy leaves. When confined with single leaves of sugar-beet and *Datura*, females of both species, but particularly those of *P. betae*, showed a marked preference for the former; in the field, no eggs were laid on *Datura* in the middle of a plot of beet. *P. betae* was successfully reared to the pupal stage only on beet; few larvae survived to the second instar and none completed development on *Chenopodium*, *Datura* or *S. nigrum*, whereas *P. hyoscyami* was successfully reared on beet, *Chenopodium* and *Datura*. In cross-breeding experiments, mating took place, but only a few eggs were laid, all sterile. *P. hyoscyami* is believed to be the more polyphagous and widely distributed of the two, and examples from beet in the French Mediterranean region all belonged to it, whereas *P. betae* is abundant in the northern half of France. The latter was collected on spinach in the Paris region, so that *P. spinaciae* (Holmgr.) is probably identical with it.

The author of the second paper briefly reviews these findings and states that Nearctic specimens of *P. hyoscyami* and *P. betae* do not exhibit the colour differences shown by these species in Europe, but the morphological differences are present. Both have been reared there from *C. album*, spinach and beet, and *P. hyoscyami* also from *D. metel*. All specimens of *P. hyoscyami* seen originated from the eastern half of North America, but specimens from Manitoba westward and a small series from Ontario and two from New York were all *P. betae*. The larvae are of considerable economic importance, especially where spinach is cultivated on a commercial scale, and serious damage to this crop occurred in British Columbia in 1956-57, in Manitoba in 1951-52, and in parts of Ontario and Quebec in 1925-27, 1931, 1950 and 1956-57. Damage to beet, sugar-beet and mangels, the leaves of which are not normally used for human consumption,

is less important; the plants usually recover from the first heavy infestation, and few are severely stunted.

TUNNOCK (A.) & RUDINSKY (J. A.). **Observations on the life-cycle of the balsam woolly aphid, *Adelges piceae* (Ratz.), in the Willamette Valley of Oregon.**—*Canad. Ent.* **91** no. 4 pp. 208–212, 3 figs., 8 refs. Ottawa, 1959.

Severe outbreaks of *Chermes* (*Adelges*) *piceae* Ratz. were first recorded in the Pacific Northwest of the United States in 1954, on *Abies lasiocarpa* in Oregon and *A. amabilis* in Washington [cf. *R.A.E.*, A **47** 340], and these trees later became heavily infested over an area of about 600,000 acres. In view of the importance of the insect, its bionomics were investigated on *A. grandis* in the Willamette Valley of Oregon in 1957, and an account of the work is given, together with a review from the literature of its life-cycle in eastern Canada [cf. **42** 262], Washington [cf. **47** 340] and Europe. Observations on development were made on samples collected during winter and spring from a heavily infested tree, and from June, when it became difficult to distinguish stages of the second and third generations, on nymphs that hatched from second-generation eggs placed on small delimited areas on the trunk of another. Favourable climatic and ecological conditions in the Valley, where the summer is hot and dry but the climate is otherwise of the marine west-coast type, enabled four generations to be completed by October 1957. The hiemosistentes, which overwinter in the first nymphal instar, had reached the second instar by 14th February and adults were present a fortnight later. First-instar nymphs and adults of the first generation of aestivosistentes were observed on 30th March and 28th May, and of the next two on 4th June and 24th July and on 8th August and 9th October, respectively. The number of generations and the duration of their development are shown on a bioclimatic curve in which precipitation is plotted against progressively accumulated hour-degrees, calculated as the sum of temperatures above 32°F. (the threshold of development). The overwintered generation completed development after 10,000 hour-degrees, the first generation of aestivosistentes after 50,000, and the second and third after 90,000 and 147,000, respectively. The number of eggs laid per female varied considerably; the hiemosistentes were the most productive, one laying over 110 eggs by 16th April. The progrediens form, which occurs only occasionally in eastern Canada, has not been observed in the Northwest.

SULLIVAN (C. R.). **The effect of light and temperature on the behaviour of adults of the white pine weevil, *Pissodes strobi* Peck.**—*Canad. Ent.* **91** no. 4 pp. 213–232, 8 figs., 10 refs. Ottawa, 1959.

The investigations described were carried out in the course of studies on the physical and biological requirements of *Pissodes strobi* (Peck), which infests white pine [*Pinus strobus*] in Canada, and the following is based largely on the author's summary and conclusions. The laboratory reactions of preconditioned adults to discrete and diffuse light sources and the effect of temperature on these responses are described and used in the interpretation of adult behaviour in the field. Differences in the behaviour patterns of young (autumn) and old (spring) adults are related to measurements of the micrometeorological aspects of their habitat and, when assessed in terms of their observed responses in the laboratory, indicate an efficient

means of survival. At room temperatures, both young and old adults were photopositive to discrete sources of light. Starvation intensified the reaction until about 48 hours before death, when the routes followed to the light became more irregular and progress considerably slower; when starved for periods extending to within 24 hours of death, the reactions of young adults became weaker and less consistent and their initial trials were marked by extended periods of inaction, but the reactions of starved old adults were more consistent and more intensely positive. When starved for up to five hours before death, adults of both ages became strongly photonegative. Both in the laboratory and in the field, young and old adults that had not been starved reacted positively to diffuse light, unless they were overheated, when their reaction was negative. The temperature at which this reversal occurred varied with the previous temperature conditioning. It was lower for young than for old adults and for starved than for fed adults of both ages conditioned to temperatures within their normal activity range (12 or 20°C. [53.6 or 68°F.]). Starved and fed adults conditioned to a temperature below their normal range (0°C. [32°F.]) showed the same reversal temperature. The reversal temperature of starved young adults conditioned to 20 and 0°C. was lower than that of similarly conditioned old adults, but age did not affect the reversal temperature of starved adults conditioned to 12°C. The lower reversal temperature of the young adults does not jeopardise survival, since, when overheated at exposed points of the habitat, they move to shaded, cooler sites where they may continue to feed. Feeding and oviposition by the old adults is, however, limited to the leading shoot, and their higher reversal temperatures permit them to remain at this exposed site over a greater temperature range.

SMIRNOFF (W. A.). **Predators of *Neodiprion swainei* Midd. (Hymenoptera: Tenthredinidae) larval vectors of virus diseases.**—*Canad. Ent.* 91 no. 4 pp. 246-248, 1 fig. Ottawa, 1959.

A polyhedral virus disease of the larvae of *Neodiprion swainei* (Middleton), which prevented them from carrying out defensive movements, was investigated in 1958 in a forest of jack pine (*Pinus banksiana*) in Quebec in which infestation had been heavy for three years and was severe in some places. The eggs of the sawfly hatched between 20th and 26th July, and the first- and second-instar larvae were preyed on by *Pilophorus uhleri* Knight, of which an average of 1-2 occurred per colony. This Mirid became less numerous after the larvae had reached the third instar, but the incidence of the diseased individuals increased in colonies in which it had been present. In an experiment in which 18 Mirids were kept in a colony of infected larvae for three days and were then transferred in groups of six to colonies of healthy larvae, virus symptoms appeared in one colony after 15 days and in the other two nine days later; the control colonies remained healthy. No polyhedra were found on the proboscis or in the gut of field-collected *Pilophorus*.

The most active predators later in the season were two wasps, of which one, *Vespa vulgaris* (L.), occurred in small numbers and the other, *V. rufa consobrina* (Sauss.), was numerous from August until the second half of September. They killed larvae that were unable to defend themselves, either because of virus infection or because they were on defoliated branches and were weakened by hunger. Polyhedra were found on the mouth-parts of some of the wasps, but not in the gut. Larvae of *N. swainei* that fed on a suspension of crushed whole wasps developed symptoms of the virus

disease after 12 days and some died after 18 days. The possibility of using infective baits for wasps and other predators as a means of spreading the disease was demonstrated in an experiment in which fresh meat smeared with a suspension of polyhedra (2.4 million per ml.) was hung from trees in an area in which the larvae were healthy; wasps were observed to feed on it, and a month later several larvae had died of the disease. This is believed to be the first record of transmission of a virus by insect predators [cf. *R.A.E.*, A 43 264].

BUCKNER (C. H.). **The assessment of larch sawfly cocoon predation by small mammals.**—*Canad. Ent.* 91 no. 5 pp. 275–282, 7 refs. Ottawa, 1959.

Five methods of assessing the destruction of cocoons of *Pristiphora erichsonii* (Htg.) by small mammals [cf. *R.A.E.*, A 48 142] were evaluated in Manitoba in connection with the formulation of life tables for this Tenthredinid on larch. They comprised 'cocoon planting', in which three-inch tree tags, each having two cocoons wired to it, were buried in the ground and the condition of the cocoons noted at intervals or after predation had ceased [cf. *loc. cit.*]; a 'collection rate' technique, in which the numbers of sound cocoons collected in unit periods before and after predation were compared; 'cocoon sampling', in which the numbers of sound cocoons at predetermined stations before and after predation were compared; a 'saturation trapping' technique, in which the numbers of adults emerging from cocoons over two similar areas were compared, from one of which all small mammals were removed by trapping; and a 'mammal exclusion cage' technique, in which emergence from known numbers of cocoons exposed to the predators was compared with that from similar numbers in mammal-proof cages. It was not possible to test all five techniques simultaneously, but the last four were compared with the cocoon planting technique. The results indicated that the cocoon planting, exclusion cage and saturation trapping methods, but not the collection rate method, give reliable estimates and that the cocoon sampling technique is probably reliable, though its use is not always practicable.

In investigations using the cocoon planting technique, the cocoons were removed each week, and the different degrees of discrimination between parasitised and unparasitised cocoons shown by various small mammals [cf. *loc. cit.*] were measured. The usefulness of the technique is demonstrated by reference to a partial life table for *P. erichsonii* in 1954–55, based on unpublished work by W. J. Turnock. The cocoon population per tree was estimated from mature larvae trapped as they dropped from the trees and subsequently allowed to spin cocoons and by random cocoon sampling during the first week in September as 1,263 and 218, respectively. From cocoons set out by the planting technique on 11th August, when many larvae were still feeding, small-mammal predation up to the time of cocoon sampling was determined as 37 per cent., and when the lower population estimate was corrected for this and for other mortality factors, a figure of 1,030 was obtained. By the last week of October, when predation had ceased, 43 per cent. of the cocoons had been destroyed by shrews and 36 per cent. by rodents. Emergence cages could not be used for assessing the surviving adult population, owing to mechanical difficulties, but, from the cocoons set out, it was estimated that adults of *P. erichsonii* emerged from 47 per cent. of the cocoons that escaped predation by small mammals, and *Ptychomyia selecta* (Mg.) (*Bessa harveyi* (Tns.)) from a further 27 per cent. The use of a secondary technique to provide a check on the

cocoon planting method is desirable, since the data obtained may sometimes be liable to error, and random cocoon sampling after predation has ceased is satisfactory for this purpose.

HOLLING (C. S.). **The components of predation as revealed by a study of small-mammal predation of the European pine sawfly.**—*Canad. Ent.* 91 no. 5 pp. 293–320, 8 graphs, 48 refs. Ottawa, 1959.

The following is based on the author's summary of this account of an investigation of the importance of small mammals in destroying cocoons of *Neodiprion sertifer* (Geoffr.), carried out mainly in the uniform environment provided by plantations of Scots pine [*Pinus sylvestris*] and jack pine [*P. banksiana*] in a sand-plain area in Ontario, in which the basic components of predation were responses to changes in prey density. For purposes of the analysis, the increase in the number of prey consumed per predator, as prey density rises, was termed the functional response, and the change in the density of predators, as a result of increase in prey density, was termed the numerical response. The three important predators (*Sorex cinereus*, *Blarina brevicauda talpoides* and *Peromyscus maniculatus bairdi*) each showed a functional response, and for each the curve relating the number of cocoons opened per day with cocoon density, whether derived from field or laboratory data, showed an initial S-shaped rise up to a constant maximum consumption. The rate of increase of consumption was highest in *Blarina* and lowest in *Peromyscus*, and the upper constant level of consumption was also highest in *Blarina*, but lowest in *Sorex*. The characteristics of these functional responses could not be explained by a simple relation between consumption and the proportion of prey in the total food available. The form of the functional response curves was such that the proportion of prey consumed per predator increased to a peak and then decreased. This peaked curve was further emphasised by the direct numerical response of *Sorex* and *Peromyscus*, since their population rose initially with increase in prey density up to a maximum that was maintained with further increase in cocoon density. *Blarina* did not show a numerical response. The increase in density of predators resulted from increased breeding, and, because the reproductive rate was so high, there was an almost immediate increase in density with increase in food.

The functional and numerical responses of predators can be affected by prey characteristics, the density and quality of alternative foods, and predator characteristics. It was shown experimentally that these affected the amount of predation by lowering or raising the functional and numerical responses. Decrease of the strength of stimulus from prey lowered both the functional and numerical responses. On the other hand, the quality of alternative foods affected the two responses differently. Increase in the palatability or in the number of kinds of food lowered the functional response but promoted a more pronounced numerical response. The peaked type of predation shown by small mammals can theoretically regulate the numbers of the prey if predation is high enough to match the effective reproduction by prey at some prey density. Even if this condition does not hold, however, oscillations of prey numbers are reduced. Since the functional and numerical responses undoubtedly differ for different species of predator, predation by each is likely to reach a peak at a different prey density. Hence, when large numbers of different species of predators are present, the declining phase of predation is displaced to a higher prey density, so that the prey have less chance to escape the regulation exerted by predators.

FENNAH (R. G.). **Nutritional factors associated with the development of mealybugs on cacao.**—*Rep. Cacao Res. Trinidad 1957-58* pp. 18-28, 4 figs., 18 refs. St. Augustine, Trinidad, 1959.

The following is virtually the author's summary. The distribution of a population of mealybugs consisting largely of *Planococcus citri* (Risso) was followed for two years in Trinidad in plots in which cacao trees, comprising three clones, were grown under different light intensities and were given different fertiliser treatments. It was found that in this environment the heaviest mealybug incidence was negatively correlated with light intensity, positively correlated with the application of nitrogen and negatively correlated with that of potassium, but showed no correlation with that of phosphorus. Heavy incidence was negatively correlated with vigour of the host plant, and this, in turn, was negatively correlated with depth of gravel below the soil surface in the rainfall conditions prevailing at the experimental site.

The incidence of mealybugs was also observed on rooted cacao cuttings subjected to various treatments. These included starvation of single nutrient elements, the administration of single nutrient elements in excessive amounts, overwatering, both in the presence of free lime and otherwise, and exposure to low diurnal humidity and high temperature.

As it was established that mealybugs were potentially associated with cacao plants with a high nitrogen status, it is possible to explain their response to host conditions induced by the experimental treatments as reflecting the effect of such treatments on the metabolism of the host, particularly with regard to the utilisation of nitrogen.

ITON (E. F.). **Studies on a wilt disease of cacao at River Estate.**—*Rep. Cacao Res. Trinidad 1957-58* pp. 55-64, 8 figs., 1 map, 10 refs. St. Augustine, Trinidad, 1959.

A wilt disease caused by *Ceratocystis fimbriata*, the symptoms of which are described, broke out simultaneously on cacao on widely separated estates in Trinidad in March 1958. The fungus was associated with boring of the trunks or branches by *Xyleborus* spp. The tree died when the beetle holes occurred on the root or trunk, but only the branches did so when infestation was confined to them. It is not known whether the fungus or the beetles attacked the trees first. The spread of the disease on one estate appeared to be correlated with the prevailing north-east trade winds, and although beetles contaminated with the fungus could travel considerable distances with these winds, the great susceptibility of these insects to desiccation renders this an unlikely method of long-range transmission. Beetles kept in jars survived for up to a day in a dry atmosphere, but many lived for 12-14 days with wet filter paper or sand. *C. fimbriata* usually behaves as a wound parasite, and attempts to isolate it from the beetles failed. The latter also bore in fallen trunks of *Erythrina* sp. and in living and dead trunks of *Gliricidia* sp.

YUST (H. R.). **Insect pests and fruit spotting of Gros Michel bananas in Ecuador.**—*FAO Plant Prot. Bull.* 8 no. 2 pp. 13-18, 4 refs. Rome, 1959.

In view of the heavy losses caused by fruit spotting of banana in Ecuador, the possibility that unsuspected insects may cause it was investigated. Many forms of spotting and discoloration of bananas occur, and they are caused by various agencies. Three species of thrips, *Palleucothrips musae* Hood, *Selenothrips rubrocinctus* (Giard) and *Frankliniella parvula* Hood, are directly responsible for spotting, but red rust, caused by the first, and

scarring, by the other two, are insignificant in comparison with a discoloration referred to as maturity staining, which is often confused with red rust and is mainly responsible for fruit rejection. It is thought to be due to retarded growth, and *Cosmopolites sordidus* (Germ.), which feeds on the rhizome and pseudostem, and the larvae of *Ceramidia viridis* (Druce), *Caerois gerdrudtus* (F.), *Opsiphanes tamarindi* Fldr. and *Ualigo* spp., which feed on the foliage, cause this and so may contribute indirectly to the stained condition.

KALSHOVEN (L. G. E.). **Studies on the biology of Indonesian Scolytoidea.**

1. *Xyleborus fornicatus* Eichh. as a primary and secondary shot-hole borer in Java and Sumatra.—*Ent. Ber.* 18 no. 8 pp. 147–160; no. 9 pp. 185–190; 6 figs., 34 refs. Amsterdam, 1958.
2. A case of primary infestation of *Glochidion* by *Xyleborus xanthopus* Eichh.—*T.c.* no. 9 pp. 190–193, 1 fig., 6 refs.
3. The occurrence of the primary twig borer *Xyleborus morstatti* Hag. in Indonesia.—*T.c.* no. 11 pp. 220–230; no. 12 pp. 244–252; 4 figs., 27 refs.

In this series of papers, the author supplements observations on three species of *Xyleborus* in Indonesia made about 1920–30 with additional information relating to the same period. In the first of them, records are given of *X. fornicatus* Eichh. as a primary pest of *Schleichera oleosa* in forest plantations in Java and Sumatra and as a suspected primary or as a secondary pest of other trees or shrubs there. Examples of this beetle were formerly identified as *X. fornicatus* or *X. fornicatus fornicator* Egg. [cf. *R.A.E.*, A 10 572; 14 138, etc.], but samples from the different plants in Indonesia were more recently identified by Schedl as *X. fornicatus*, and re-examination of all the available material showed that, in spite of some variation in size, it was impossible to distinguish more than one form [cf. 36 251; 46 113]. The outbreaks on *S. oleosa* usually occurred in mixed plantations. In one that occurred in young trees in the Margasari range in central Java in 1920, it was observed that the adult females swarmed mainly at noon and gained entrance through the folds of bark at the base of side branches or through leaf-scars and other crevices. Galleries were bored straight through the bark into the wood and then took the form of horizontal branched tunnels that ran roughly parallel to the bark, but they were sometimes cut in the bark itself. The walls were lined with ambrosia fungus. All stages from egg to adult were found in the galleries in March–May (the rainy season) and a brood appeared to consist of 15–20 offspring [cf. 30 232], of which about 90 per cent. were females. The damage caused, which is described, renders the trees unsightly and attractive to termites, but becomes serious only when infestation is heavy. Few trees are killed, but infested tops and branches tend to break, and die-back may occur. About 20 per cent. of the saplings in two adjacent plots were infested, but the rate was 80 per cent. in one part of them and mortality there was 8 per cent. The best developed plants were attacked, and branches with a diameter of less than  $\frac{3}{4}$  in. were not infested. Other attacks on young trees are noted. Mature trees up to about 1 ft. in diameter showed no active infestation in central Java, though some showed traces of earlier attack. Inspection of the main infested area 4–11 years later showed that the outbreak had ceased soon after its discovery and that there had been no reinfestation in the interim. Primary attacks on 19 other species of trees were observed in various localities, but in few was the borer able to penetrate into the wood and in most the flow of sap or resin impeded activity. Tea was occasionally infested in Java and Sumatra [cf. 13 139], and castor (*Ricinus communis*) in Java, particularly when the

plants were in full foliage but had fruited and begun to decline. Secondary infestation occurred in various plants in an unhealthy condition, but was not invariably successful.

An outbreak of *X. xanthopus* Eichh. on a species of *Glochidion*, probably *G. kollmannianum*, in a forest plantation at Goalpara (altitude 2,950 ft.) in Java is described in the second paper. It was observed in September 1920, and investigations showed that branched galleries were bored in a horizontal plane and that the females in them were accompanied by up to 32 offspring in various stages of development. Other records of infestation by *X. xanthopus* are reviewed.

In the third paper, the author reviews the early records of *X. morstatti* Hag. in Sumatra, Java [cf. 14 522], Celebes and Borneo, with special reference to its incidence on coffee. The food-plant range of this species includes plants in nine families. It may be indigenous in Sumatra, but was certainly not originally present over central and eastern Java; it has long existed in Celebes. Its ecology is compared with that of *X. morigerus* Bldf., which also attacks coffee and accompanies or has been replaced by *X. morstatti* in some places. *X. morstatti* was involved in a complex causing die-back of young *Eusideroxylon zwageri* near Palembang, Sumatra, in February 1924, and caused severe losses of seedlings of Java coca. *Erythroxylon novagranatense*, in nursery beds in West Java in 1924-25. Galleries in the twigs of the latter extended upwards and downwards for a distance of about  $\frac{3}{4}$  in. Single adult females were present in the galleries in December, with 13-50 offspring in various stages; the young adults comprised about 4-5 females to each male. Not more than 20 offspring were found per female in June and September, and ten was a more usual number. An unidentified Hymenopterous parasite was found in 6 per cent. of the galleries in June and in 2 per cent. of them in September. Attacks on other plants present are noted, and an infestation of the year-old shoots of coffee in the same locality in June 1925 is described. An appendix contains records of *X. morstatti* on various plants in Malaya collected by F. G. Browne.

BUROV (D.). **The distribution and biology of the strawberry root weevils (*Otiorrhynchus rugosostriatus* Goeze and *O. ovatus* L.) in Bulgaria.** [In Bulgarian.]—*Nauch. Trud. agron. Fak. selsk. Inst. Dimitrov*, 7 pp. 479-486, 1 map, 2 refs. Sofia, 1959. (With summaries in Russian & German.)

*Otiorrhynchus rugosostriatus* Goeze and *O. ovatus* (L.) have been the most injurious insect pests of strawberry in Bulgaria of recent years. These weevils occur almost throughout the country, and *O. rugosostriatus* forms 70-90 per cent. of the population. The adults emerge in June, at the time of picking, and this renders them difficult to control with insecticides. They oviposit about ten days later, and a few overwinter, though about 95 per cent. die in autumn. The larvae hatch in 20 days, feed on the roots of the plants, and overwinter, resuming feeding in spring and pupating in May. The pupal stage lasts 20-30 days.

MANNINGER (G. A.), MANNINGER (V.), CSUKÁS (L.) & ENDRÖDY (E.). **A lucernacséplés szerepe a lucernamagdarázs (*Bruchophagus roddei* Guss.) kártételének megakadályozásában.** [The rôle of threshing in the control of *B. roddei*.]—*Növénytermelés* 7 no. 3 pp. 257-264, 5 figs., 9 refs. Budapest, 1958. (With summaries in Russian & English.)

*Bruchophagus roddei* (Guss.) [cf. R.A.E., A 47 339] causes losses of up to 36 per cent. of the lucerne seed grown in Hungary. Flowering of the

crop is protracted and infestation gradual, so that chemical control is impracticable, but as infested seeds are blown into the chaff by the machines used for threshing, burning the chaff is a useful repressive measure. It may also be fed to animals or used for silage.

BAKKE (A.). **Mass attack of *Brachonyx pineti* Payk. (Col., Curculionidae) on pine forests in Norway.**—*Medd. Skogforsøksv.* no. 50 pp. [3 +] 125–142, 8 figs., 17 refs. Oslo, 1958. (With a summary in Norwegian.)

In Norway, *Brachonyx pineti* (Payk.) occurs in districts round the Oslofjord, along the south and west coasts and in the outer coastal districts of Trøndelag, and it began to cause serious injury to pines (*Pinus sylvestris*) on Søndre Langåra, an island in the Oslofjord, in 1949; by 1956, about three-quarters of the trees had been attacked and a quarter were dead or dying.

The author describes all stages of the weevil and gives details of its life-history [cf. *R.A.E.*, A 27 355] on the island. The adults overwinter among old pine needles and leaves on the ground until early May, when they move up into the trees, mate and oviposit in undeveloped needles within the buds, piercing the covering scales to reach them. The larvae pass through three instars and feed and pupate in the rudimentary needles, which do not develop after attack. Larvae were found from the end of May to the beginning of July, and pupae from 24th June onwards; adults were present from 9th July, and many had left the buds by 23rd July, to feed on the parenchymal tissue of needles of the current year until October, when they entered hibernation. The length of life of the adult is not known, but overwintered examples were found as late as 9th July.

Each larva prevented two pine needles from developing and adult feeding destroyed many needles, so that a serious attack considerably reduced assimilation by the tree; repeated attacks in successive years killed them. Secondary insects may breed in weakened trees, but have not done so to any extent on Søndre Langåra. Parasites reared from *Brachonyx* larvae comprised *Habrocytus parvinnucha* Thoms., *Trichomalus helvipes* (Wlk.) and small numbers of *Eurytoma curculionum* Mayr, *Eupelmus urozonus* Dalm. and two species of *Tetrastichus*, but they have apparently given little control. A DDT aerosol released on 4th September from a 10 per cent. DDT solution at the rate of 1½ gal. per acre by means of a TIFA machine [cf. 35 259] killed many adults and reduced infestation in the following spring.

HERTING (B.). **Biologie der westpaläarktischen Raupenfliegen, Dipt., Tachinidae.** [Biology of the West Palaearctic Tachinids.]—*Monogr. angew. Ent.* no. 16, 188 pp., 12 figs., 15 pp. refs. Hamburg, P. Parey, 1960. Price DM.32.

This is the first comprehensive survey of Tachinids as parasites of insects since that published by W. Baer in 1920–21 [*R.A.E.*, A 9 61, 252], and much information has become available in the interim. The geographical area covered by the present work comprises Europe, North Africa and the Near East, in which about 800 species of Tachinids occur. Some 330 have been reared from their hosts, and these, with about 70 of unknown biology, form the subject of the book. The early sections comprise reviews of the morphology of the immature stages and of the female genitalia of Tachinids, the ways in which parasitism is effected, parasite development, host specificity and host selection, and the natural enemies and diseases of Tachinids, and these are succeeded by a systematic list of the individual species (pp. 33–147), with information on their synonymy, distribution,

hosts, flight period and sometimes other bionomics and morphology, notably that of the puparium. A list of the hosts showing the species that attack them follows, and there is an index to all the genera and species of Tachinids mentioned. The work is based on the author's own studies, museum collections, and the literature, many errors in which are rectified.

STEINER (P.) & GRUCH (W.). **Zur Toxikologie der Insektizide. Literatur-übersicht. 1. Teil: Dien-Gruppe.** [The toxicology of insecticides. A review of the literature. Part 1: the diene group.]—*Mitt. biol. Bundesanst. Berl.* pt. 95, 118 pp., 14 pp. refs. Berlin, 1959.

This is the first of a proposed series in which the scattered information on the toxicology of various groups of insecticides is to be brought together. It deals with compounds of the diene group (aldrin, dieldrin, endrin, isodrin, chlordane, heptachlor and hexachlorocyclopentadiene) and consists of a short review of the principal works on their toxicology, followed by summaries of information on the nomenclature, chemical composition, physical and chemical properties, use against pests of plants, toxicity to mammals, birds, fish, etc., pharmacology and biochemistry, storage and elimination in vertebrates, pathology, curative measures, residues, tolerances and effects on flavour of each of them, and relevant references to the literature.

#### PAPERS NOTICED BY TITLE ONLY.

NOUR (H.) & SIDAROUS (F.). **The effectiveness of some insecticides on *Trogoxylon impressus* Com. (Coleoptera: Lyctidae).**—*Bull. Soc. ent. Egypte* 42 pp. 285–289, 1 graph. Cairo, 1958. [Cf. *R.A.E.*, A 47 414.]

RAINEY (R. C.). **The use of insecticides against the desert locust [*Schistocerca gregaria* (Forsk.): a review of the literature].**—*J. Sci. Fd Agric.* 9 no. 10 pp. 677–692, 6 figs., 64 refs. London, 1958.

BRČÁK (J.). **Änderungen der Infektiosität des Tabakmosaikvirus während der Passage durch den Darm von *Barathra brassicae* (L.).** [Changes in the infectivity of tobacco mosaic virus during passage through the gut of *Mamestra (Barathra) brassicae*.]—*Phytopath. Z.* 30 pt. 4 pp. 415–428, 3 figs., 17 refs. Berlin, 1957.

GEORGE (J. A.). **Note on *Epigonatopus plesius* (Fenton) [i.e. *plesius* Fenton] (Hymenoptera: Dryinidae), a parasite of the six-spotted leafhopper, *Macrosteles fascifrons* (Stal), in Ontario.**—*Canad. Ent.* 91 no. 4 p. 256, 1 ref. Ottawa, 1959.

HAWES (I. L.). **Index XII to the literature of American economic entomology 1952.**—*Spec. Publ. ent. Soc. Amer.* no. 12, [8+] 321 pp., frontis. Washington, D.C., 1954. **Index XIII . . . 1953.**—*Op. cit.* no. 13, [7+] 303 pp. 1955. **Index XIV . . . 1954.**—*Op. cit.* no. 14, [7+] 306 [+6] pp. 1956. **Index XV . . . 1955.**—*Op. cit.* no. 15, [7+] 329 [+6] pp., frontis. 1957. CUSHMAN (H. G.). **Index XVI . . . January 1, 1956–December 31, 1957.**—*Op. cit.* no. 16, [10+] 694 pp. 1959. [Cf. *R.A.E.*, A 43 384.]

## A REVIEW OF BIOLOGICAL CONTROL OF INSECTS AND WEEDS IN AUSTRALIA AND AUSTRALIAN NEW GUINEA

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## INDEX OF AUTHORS

- ANON, 176.  
Alkan, B., 154.  
Allen, W. W., 176.  
André, M., 164.  
Andrewartha, H. G., 184.  
Archer, T. E., 186.  
  
Bacon, O. G., 180.  
Bailey, S. F., 181.  
Baker, E. W., 149.  
Bakke, A., 195.  
Baltensweiler, W., 155.  
Becker, G., 157.  
Bennett, F. D., 170.  
Blaesen, P., 160.  
Boettiger, E. G., 184.  
Born, D., 179.  
Brammanis, L., 153.  
Brčák, J., 196.  
Bremer, H., 163.  
Brito da Cunha, A., 184.  
Brock, A. M., 151.  
Brown, A. W. A., 184.  
Buckner, C. H., 190.  
Bullman, O., 157.  
Burov, D., 194.  
  
Calcat, A., 176.  
Capek, M., 155.  
Carden, P. W., 171.  
Carman, G. E., 184.  
Cassil, C. C., 185, 186.  
Cassell, G. H., 167.  
Chilloot, J. G., 157.  
Christenson, L. D., 184.  
Cohie, F., 164.  
Collingwood, C. A., 151.  
Courshee, R. J., 184.  
Craig, R., 184.  
Cram, W. T., 183.  
Crooke, M., 153.  
Crowson, R. A., 184.  
Csukás, L., 194.  
Cushman, H. G., 196.  
  
d'Aguilar, J., 187.  
Davis, C. S., 180.  
De Lotto, G., 163.  
Delucchi, V., 154.  
Dlabola, J., 162.  
Dosse, G., 155.  
Drouillon, R., 164.  
  
Eady, R. D., 167.  
Edwards, G. A., 184.  
Eichhorn, O., 156.  
El-Nahal, A. K. M., 173, 174.  
Endrödy, E., 194.  
  
Faber, W., 157.  
Fennah, R. G., 192.  
Fernando, H. E., 169.  
Fisher, T. W., 178.  
Flanders, S. E., 178.  
Foote, R. H., 184.  
Franz, J., 159.  
Fullmer, O. H., 185, 186.  
  
Genung, W. G., 182.  
George, J. A., 196.  
Georgiou, G. P., 150.  
Gressitt, J. L., 178.  
Gruch, W., 196.  
Gunn, D. L., 184.  
Gysin, H., 185.  
  
Hafez, Mostafa, 175.  
Hagnauer, W., 173.  
Harris, K. M., 166.  
Hassanein (Hassanien), M. H., 174, 176.  
Hawes, I. L., 196.  
Hayes jr., W. J., 185.  
Hayship, N. C., 182.  
Herold, F., 163.  
Herting, B., 195.  
Hewlett, P. S., 150.  
Hocking, B., 184.  
Holling, C. S., 191.  
Hughes, J. T., 151.  
  
Iton, E. F., 192.  
  
Jahn, E., 153.  
Jeppson, L. R., 181, 184.  
  
Kalshoven, L. G. E., 193.  
Kangas, E., 153.  
Karafiat, H., 149.  
Kerr, S. H., 182.  
Kovačević, Z., 154.  
Krezal, H., 149.  
Kruel, W., 156.  
  
Lange, W. H., 180, 181.  
Lloyd, J. H., 164.  
  
Maassen, H., 162.  
McGregor, S. E., 184.  
Madsen, H. F., 179.  
Manninger, G. A., 194.  
Manninger, V., 194.  
Margot, A., 185.  
Martini, C., 180.  
Megahed, M. M., 173.  
Merkel, E., 156, 158.  
Michelbacher, A. E., 180.  
Missonnier, J., 187.  
Moore, B. P., 150.  
Moreau, J. F., 155.  
Morris, R. F., 184.  
  
Neuffer, G., 160.  
Niechziol, W., 158.  
Nour, H., 196.  
Nuggehalli, R. N., 151.  
  
Ossowski, L. L. J., 152.  
  
Painter, R. H., 183.  
Pathak, M. D., 183.  
Patočka, J., 154.  
Pfeffer, A., 154.  
Pingale, S. V., 151.  
Post, G. R., 180.  
Prevett, P. F., 168.  
  
Pritchard, A. E., 149.  
Pschorn-Walcher, H., 154.  
  
Rainey, R. C., 196.  
Read, W. H., 151.  
Réal, P., 165.  
Rekk, G. F., 149.  
Retan, A. H., 180.  
Richter, G., 161.  
Riehl, L. A., 181.  
Robinson, F. A., 182.  
Roonwal, M. L., 152.  
Rudinsky, J. A., 188.  
  
Schaarschmidt, L., 149.  
Schaerffenberg, B., 157.  
Scheucher, R., 149.  
Schimitschek, E., 152.  
Shoeb, A., 173.  
Sidarous, F., 196.  
Sinreich, A., 153.  
Smirnov, W. A., 189.  
Smith, K. G., 168.  
Smith, R. F., 176, 184.  
Smith, S. G., 184.  
Smithers, C. N., 172.  
Soliman, A. A., 173.  
Soliman, S. A., 173.  
Stammer, H. J., 149.  
Steiner, H., 160.  
Steiner, P., 196.  
Steinhaus, E. A., 184.  
Stern, V. M., 179.  
Stüben, M., 160.  
Subrahmanyam, V., 151.  
Sullivan, C. R., 188.  
Swaminathan, M., 151.  
  
Thielemann, R., 160.  
Thorsteinson, A. J., 184.  
Todd, F. E., 184.  
Tonks, N. V., 183.  
Tunnock, A., 188.  
Türk, E., 149.  
Türk, F., 149.  
  
van den Bosch, R., 179.  
Van der Kloot, W. G., 184.  
Venkatrao, S., 151.  
von Kleist, I., 156.  
Voüte, A. D., 153.  
  
Walker, P. T., 171.  
Wedding, R. T., 181.  
Weesner, F. M., 184.  
Weiser, J., 154.  
Wellenstein, G., 156, 159.  
Weyer, F., 185.  
Whalley, P. E. S., 163.  
Williams, D. J., 163.  
  
Yaffe, J., 185.  
Yust, H. R., 192.  
  
Zaki, M. M., 176.  
Zoebelein, G., 155.  
Zweig, G., 188.  
Zwölfer, H., 154.

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# CONTENTS.

	PAGE
AFRICA: The control of <i>Kotochalia junodi</i> in South Africa ...	152
AFRICA: Parts of a revision of the mealybugs ...	163
AFRICA: Dieldrin protecting timbers from <i>Xylocopa</i> in Uganda ...	163
AFRICA: A review of locust control by aircraft ...	164
AFRICA: Use of endrin against <i>Stephanoderes hampei</i> in Oubangui-Chari ...	164
AFRICA: <i>Dysmicoccus brevipes</i> and pineapple wilt in the Ivory Coast...	165
AFRICA: Cecidomyiids attacking crops in Nigeria...	166
AFRICA: <i>Brevipalpus californicus</i> on <i>Citrus</i> in Senegal ...	164
AFRICA: The active form of <i>Callosobruchus maculatus</i> in Nigeria ...	167
AFRICA: Studies on stored rice and its pests in Sierra Leone ...	168
AFRICA: Seed treatments against <i>Melanagromyza phaseoli</i> in Tanganyika ...	171
AFRICA: Observations on <i>Busseola fusca</i> in Southern Rhodesia ...	172
AFRICA: Phosphamidon controlling cotton pests in Egypt ...	173
AFRICA: <i>Earias insulana</i> in maize ears in Egypt ...	173
AFRICA: Treatments against <i>Thrips tabaci</i> on cotton in Egypt ...	174
AFRICA: The bionomics of <i>Plutella maculipennis</i> in Egypt ...	174
AFRICA: Studies on a virus of <i>Prodenia litura</i> in Egypt...	175
AFRICA: Pests of date palms in the north ...	176
AMERICA: Indexes to the literature of economic entomology 1952-57 (Titles only) ...	196
AUSTRIA: An outbreak of <i>Bupalus piniarius</i> and its control ...	153
AUSTRIA: An investigation on cereal bugs ...	157
BRITAIN: Parathion in greenhouses and residue hazards to workers ...	151
BRITAIN: Seasonal history of <i>Cecidophyes ribis</i> on black currant ...	151
BRITAIN: The sawflies that infest conifers...	153
BRITAIN: Seed treatments against <i>Hylemyia antiqua</i> ...	171
BULGARIA: <i>Otiorynchus</i> spp. on strawberry ...	194
CANADA: <i>Cnephasia longana</i> occurring in British Columbia ...	186
CANADA: Status and bionomics of <i>Pegomya hyoseyami</i> and <i>P. betae</i> ...	187
CANADA: Effects of light and temperature on <i>Pissodes strobi</i> ...	188
CANADA: Predators spreading a virus disease of <i>Neodiprion swainei</i> ...	189
CANADA: Cocoons of <i>Pristiphora erichsonii</i> and small mammals...	190
CANADA: Small mammal predators and cocoons of <i>Neodiprion sertifer</i> ...	191
CANADA: A Dryinid parasitising <i>Macrosteles fascifrons</i> (Title only) ...	196
CEYLON: The susceptibility of <i>Scotinophara lurida</i> to insecticides ...	169
CYPRUS: Mites infesting various crops ...	150
CZECHOSLOVAKIA: A possible method of controlling <i>Trypodendron lineatum</i> ...	154
CZECHOSLOVAKIA: Two Lepidoptera infesting fir ...	154
CZECHOSLOVAKIA: Microsporidia infesting <i>Eriogaster lanestris</i> ...	154

[Continued on p. iv of cover

# CONTENTS—cont.

	PAGE
CZECHOSLOVAKIA: Bark-beetles and their natural enemies ... ..	155
CZECHOSLOVAKIA: <i>Calligypona pellucida</i> and damage to oats ... ..	162
ECUADOR: Insects and spotting of bananas ... ..	192
EUROPE: Parts of a work on the Acarina (Review) ... ..	149
FINLAND: The bionomics of <i>Pissodes gyllenhali</i> ... ..	153
FRANCE: Status and bionomics of <i>Pegomyia hyoscyami</i> and <i>P. betae</i> ... ..	187
GERMANY: Soil conditions favouring <i>Pristiphora abietina</i> ... ..	158
GERMANY: A new species of <i>Typhlodromus</i> ... ..	155
GERMANY: Effect of DDT aerosols on the forest fauna ... ..	156
GERMANY: <i>Chermes</i> spp. and winter cold ... ..	156
GERMANY: The value of <i>Formica rufa</i> as a predator ... ..	156
GERMANY: Climate and the occurrence of forest pests ... ..	156
GERMANY: Effect on parasites of sprays against <i>Choristoneura murinana</i> ... ..	159
GERMANY: Insecticides against aphids on beet ... ..	160
GERMANY: Light eliminating hibernation in <i>Piesma quadratum</i> ... ..	160
GERMANY: A survey of the flight years of <i>Melolontha</i> spp. ... ..	161
GERMANY: <i>Macrosiphum malvae rogersti</i> as a vector of strawberry virus ... ..	162
GERMANY: <i>Aphis fabae</i> injuring cucumbers... ..	163
HOLLAND: Food factors affecting density of forest pests ... ..	153
HUNGARY: <i>Bruchophagus roddi</i> on lucerne and its control ... ..	194
INDIA: Effect of infestation by <i>Calandra oryzae</i> on stored sorghum ... ..	151
INDIA: A review of research on forest entomology ... ..	152
INDONESIA: Notes on infestations by three species of <i>Xyleborus</i> ... ..	193
ITALY: Wood-infesting insects at Chioggia ... ..	157
MAURITIUS: Introduction of parasites of pests of pigeon pea ... ..	170
NEW CALEDONIA: Notes on <i>Dialeurodicus elongatus</i> and other Aleyrodids ... ..	164
NEW GUINEA: New Encyrtid parasites from <i>Nacoleia octasema</i> ... ..	167
NORWAY: An outbreak of <i>Brachonyx pineti</i> on pine ... ..	195
PALAEARCTIC REGION: A monograph on the Tachinids (Review) ... ..	195
SWITZERLAND: <i>Cnemodon</i> spp. predacious on <i>Chermes piceae</i> ... ..	155
SWITZERLAND: <i>Phytodietus</i> sp. parasitising <i>Enarmonia griseana</i> ... ..	155
TURKEY: The pests of tea ... ..	154
U.S.A.: Insects first reported in January–September 1959 ... ..	176
U.S.A.: Investigations on <i>Apanteles medicaginis</i> parasitising <i>Colias eurytheme</i> ... ..	176
U.S.A.: The problem of establishing <i>Casca chinensis</i> in California ... ..	178
U.S.A.: Selective control of <i>Therioaphis maculata</i> in California ... ..	179
U.S.A.: Sprays against fruit-tree mites in California ... ..	179
U.S.A.: <i>Tyrophagus dimidiatus</i> on spinach in California and its control ... ..	180
U.S.A.: Sprays against <i>Cydia latiferreana</i> on walnuts ... ..	180
U.S.A.: Determination of Sevin residues in wine ... ..	186
U.S.A.: Endrin baits against <i>Euxoa messoria</i> on asparagus ... ..	181
U.S.A.: Effects of feeding by <i>Panonychus citri</i> on <i>Citrus</i> ... ..	181
U.S.A.: Control of <i>Blissus insularis</i> in Florida ... ..	182
U.S.A.: <i>Argyrotaenia ivana</i> on celery in Florida and its control ... ..	182
U.S.A.: Effects of biotypes of <i>Aphis maidis</i> on sorghum and barley ... ..	183
U.S.A.: The life-cycle of <i>Chermes piceae</i> in Oregon ... ..	188
WEST INDIES: Parasites of <i>Ancylostomia stercorrea</i> in Trinidad ... ..	170
WEST INDIES: Nutritional factors and mealybugs on cacao in Trinidad ... ..	192
WEST INDIES: <i>Xyleborus</i> spp. and <i>Ceratocystis fimbriata</i> on cacao in Trinidad ... ..	192
YUGOSLAVIA: Factors in the spread of <i>Hyphantria cunea</i> ... ..	154
Keys to Tetranychid mites ... ..	149
A revision of the Tenuipalpids ... ..	149
Chemical structure and synergistic activity in methylenedioxyphenyl compounds ... ..	150
Commemorative volume for W. Zwölfer's sixtieth birthday ... ..	152
Continuous feeding by aphids ... ..	160
An insect light-trap independent of mains current... ..	160
Effects of insecticides on larvae of <i>Prodenia litura</i> ... ..	173, 176
Annual review of entomology, Vol. 5 (Review) ... ..	184
Chemistry and toxicological properties of diazinon ... ..	185
Stabilisation of Aramite by glycols ... ..	185
Colorimetric microdetermination of Tedion ... ..	185
Persistence of Tedion residues on fruits ... ..	186
Review of literature on the toxicology of diene insecticides ... ..	196
Effectiveness of insecticides against <i>Trogoxylon impressum</i> (Title only) ... ..	196
The use of insecticides against <i>Schistocerca gregaria</i> (Title only) ... ..	196
Infectivity of a virus during passage through <i>Barathra brassicae</i> (Title only) ... ..	196